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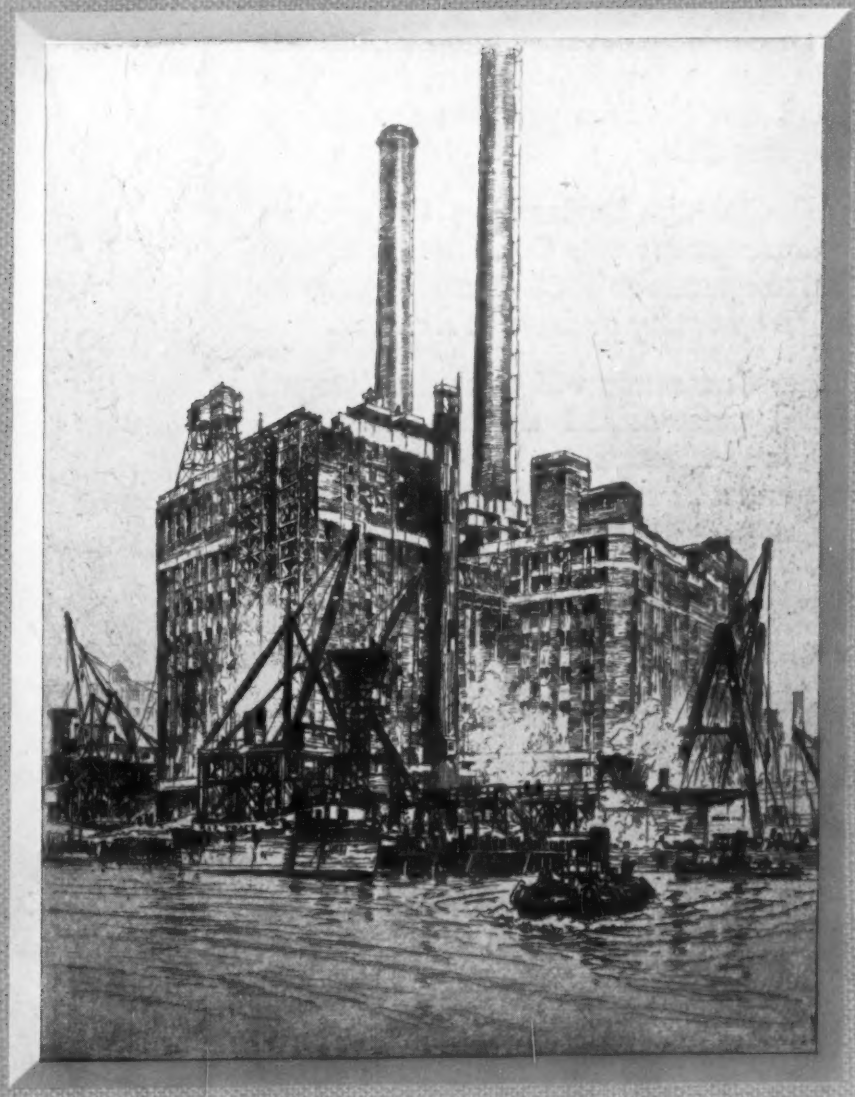

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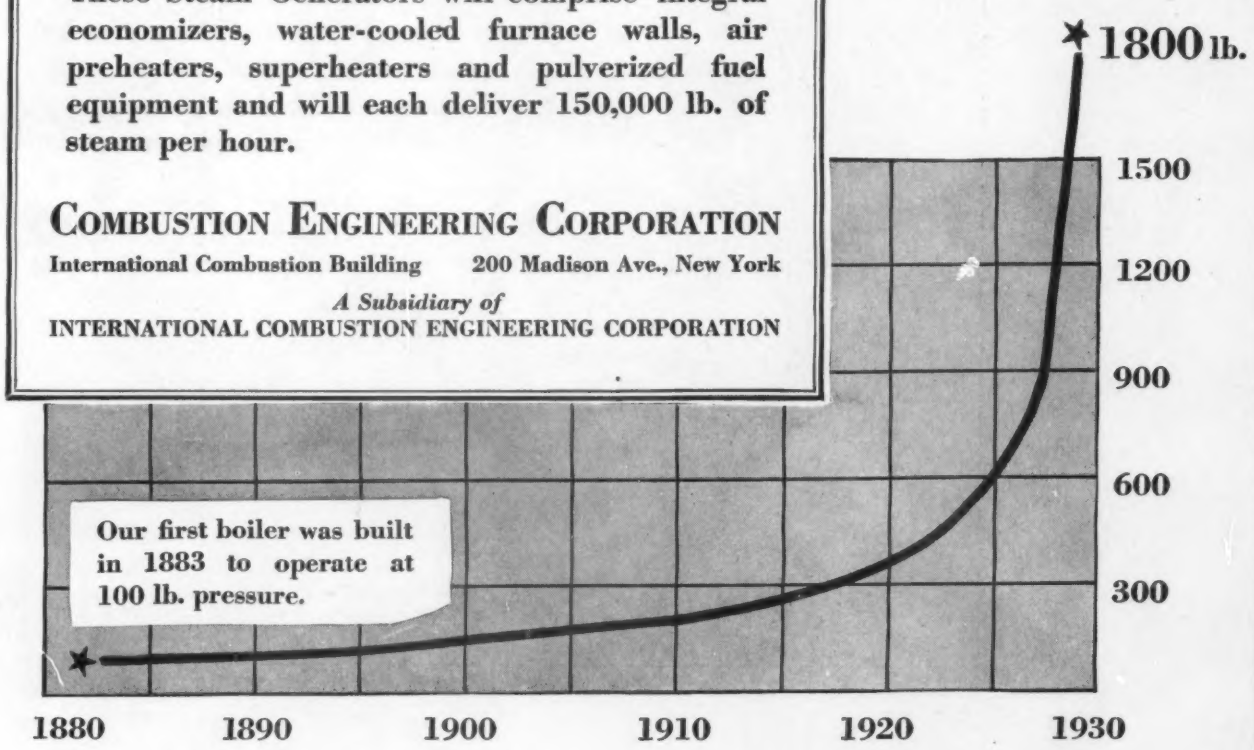

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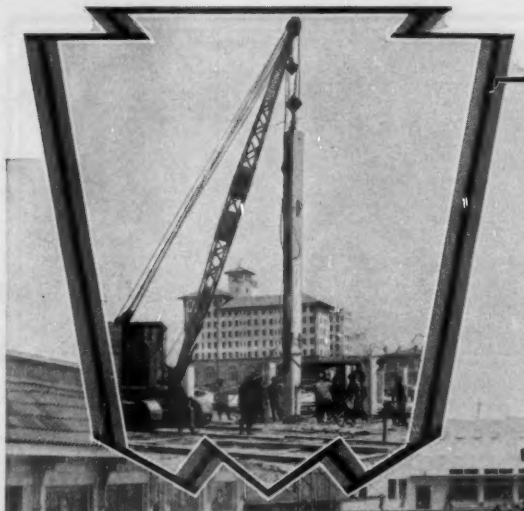

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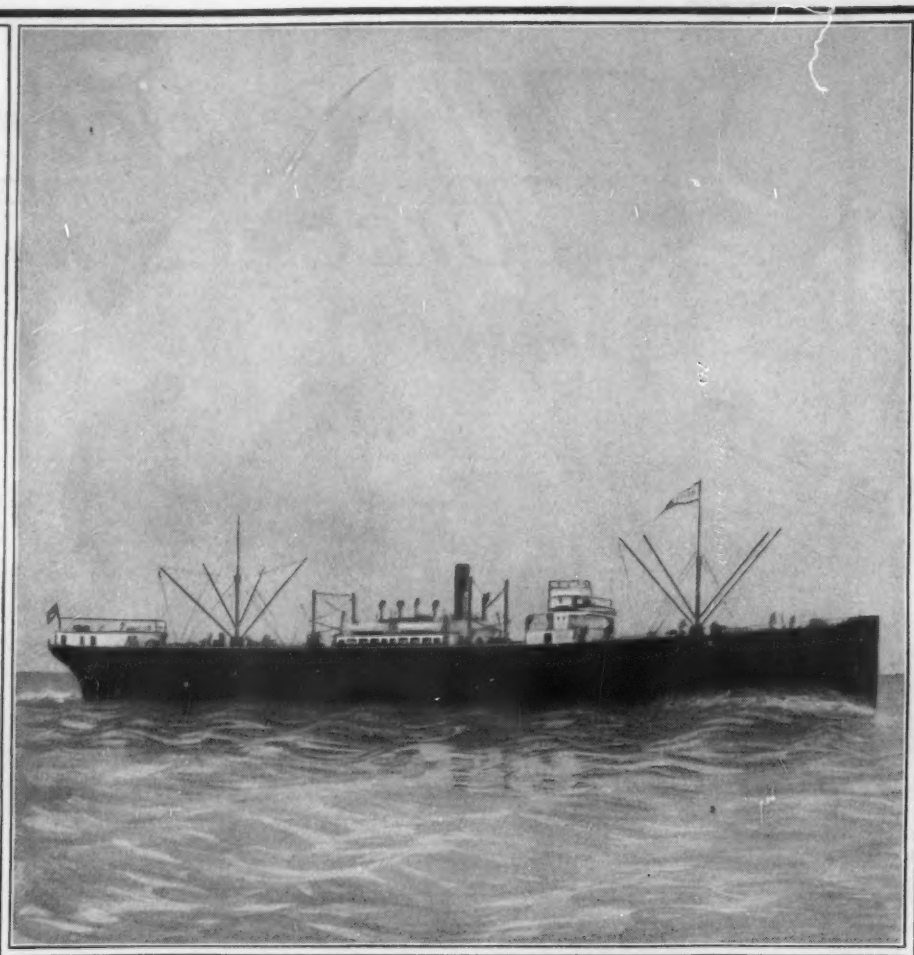

YOUNGER COLLEGE MEN
ON RECENT WESTINGHOUSE JOBS

DEO. DEWSEN,
Traction Apparatus Sales,
Oregon State College, '24

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General Engineering,
Alabama Polytechnic Institute, '22

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Headquarters Sales,
University of Kentucky, '19

H. C. MANNING,
Motor Engineering,
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The "Triumph" and "Defiance"

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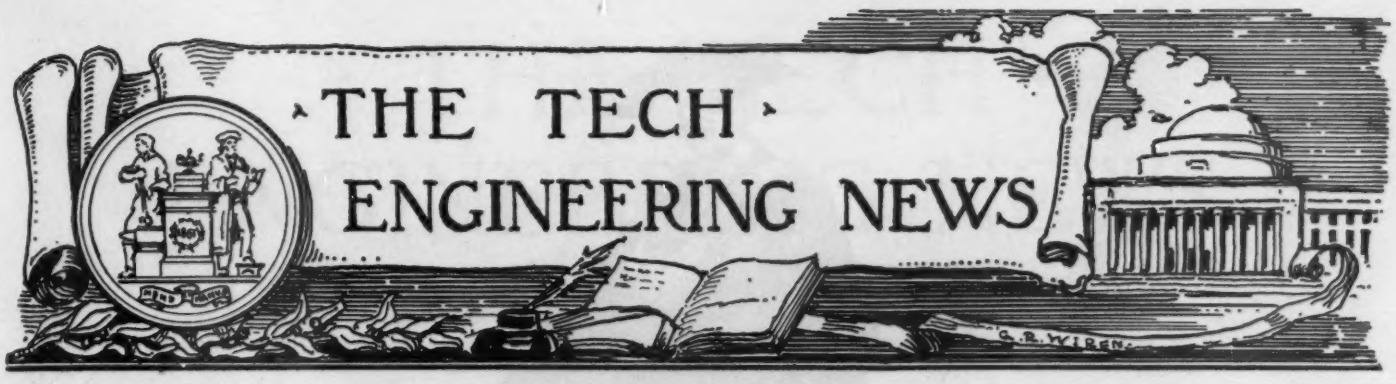

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TABLE OF CONTENTS

	Page
THE PROPER ATTITUDE IN BUSINESS. By Nathan H. Daniels '96	325
THE RESEARCH LABORATORY OF APPLIED CHEMISTRY. By Henry O. Forrest '20	327
TECHNICAL JOURNALISM. By David O. Woodbury '21	328
METEOROLOGICAL PROBLEMS AND THEIR APPLICATIONS. By Carl-Gustaf A. Rossby	329
THE SINGLE SLEEVE VALVE ENGINE. By Dean A. Fales '14	330
THE CENTRAL POWER PLANT IN MARINE USE. By Commander Q. B. Newman	332
EDITORIALS	335
THE ENGINEERING FIELD	336
DEPARTMENTAL NOTES	338
RECENT BOOKS	340

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VOLUME IX JANUARY, 1929 NUMBER 8

The Proper Attitude in Business

Advice for the young engineer concerning his viewpoint toward his work and his employers

By NATHAN H. DANIELS '96
Stone & Webster, Inc.

IN previous discussions of the problems and opportunities which lie before the engineering graduate, various persons have stressed the engineering aspect of the question, as that is the one which Technology men are first apt to consider, but I want to emphasize the fact that the human and business aspects of the problem are fully as important as the technical; in fact, they may be of even greater importance for, by reason of your training and background, you are very apt to subordinate the human and business problems to those of technical interest. You will find, however, that even in purely engineering positions the question of how you do things is often as important as what you do, and perfect technical procedure may be marred by poor human technique.

Fair ability, if accompanied by a reasonable consideration for the wishes of your employer and for the opinions of your associates, will oftentimes carry you further than excellent work with but poor human qualities. In order that your work may produce the full measure of success, measured in material things, it is not only necessary that it please you, but it must also please your employer and his associates, for they are the ones who are paying the bills. Hence, you must learn to look at things not only from your own point of view, but from that of your employer and from that of the world at large. It is surprising how much you can facilitate your progress, how much you can add to your share in the good things of life, by a careful consideration of this phase of the situation.

If I were to stop here you would perhaps carry away the impression that I was referring to the usual social graces, such as saying "Good morning" and "Thank you," so rather than talking generalities I am going to tell you of a number of typical cases.

I know you will pardon me if, for the first illustration, I draw from my own experience starting out in the business world. I had graduated from Technology as an electrical engineer and had taken a post-graduate course. My first position was with a company manufacturing machinery for making tin cans. While it may seem strange for an electrical engineer to have made such a connection, there were a number of factors which made it the most attractive proposition I received. At that time most small packers of canned goods purchased their empty cans from the manufacturers. The company by whom I was employed was developing a line of machinery of moderate capacity adapted for the use of such small plants as wished to make their own cans.

Mr. Daniels' article, with a few minor changes and some added examples, was recently presented in the form of a talk before the Electrical Engineering Society. Himself a graduate of the Institute, he has had a great deal of contact in the past with students enrolled in the Stone and Webster option of the coöperative course in electrical engineering. In such a position, he has been able to observe those characteristics which make for success and those which hinder a young engineer's advancement. His advice is well worth serious consideration.

After a course in the factory where I learned about the manufacture of the machines and the different points to be considered in servicing them, it was thought best to let me go on the road selling for a time. I had received practically no instruction in selling, no coaching whatsoever, but this did not worry me. I started out fully prepared to bring the world to my feet. I knew the machines thoroughly, knew their capacity, knew all their good points — and what more equipment could a salesman need?

The customers whom I visited divided into three classes. There were those who already had our machines in operation. I called upon a number of them, looked over their outfits, made some helpful suggestions and received an occasional order for new equipment. There there were those who had written inquiring about our machinery. They were already at least half sold on the idea of putting in the machines, and I called upon them with the object of interesting them further and answering such questions as they had on their minds. This I was able to do with fair success, and I actually landed an order for an entirely new installation.

Beyond this was a third class of prospects, the most numerous and in many ways the most important. They were the ones who had never considered making their own cans and who knew nothing about our line of machinery. I called upon several such

prospects, prepared to tell them all about the machines, how our shafts were ground, how our cams were hardened, all the mechanical details of the make-up, the things in which I felt they really should be interested. But instead of arousing interest I ran up against a stone wall. When I wanted to tell about our machine, the prospect would look at me and say: "Why should I consider putting in machinery of this sort? I buy good cans now and I'm entirely satisfied." Or, "Can I save any money by putting in this machinery?" Now I was in no position to answer these or similar questions. I had never considered the proposition from that angle and yet, after I had been turned out — and in two cases practically kicked out — by reason of my lack of this information, I decided that there was a great deal I didn't know about selling and I began to make up a little line of selling talk calculated to interest the prospects who had never heard of us.

I began to gather statistics on can making, of costs and everything of that kind and soon I was equipped to approach a prospect in this way:

"I wonder whether you have ever considered putting in a line of machinery and making your own cans rather than buying them as you are probably doing at the present time. A number of large packers are doing this as they find that they are able to get a better can and that they are able to keep their employees working all the year around instead of laying them off during the winter season as at present. The plan has many real advantages, it will save you money, and I feel that it will repay you for making a careful study of the situation. We have a line of machinery which is adapted for just that purpose, and I should like to go over the proposition with you and show that it is to your advantage to consider putting it in."

In order to appeal to the men whom I had to meet and who were not trained engineers, it was necessary for me to put myself in their place, to recognize their point of view and to give them, not the information I wanted them to have, but that which they were desirous of getting. By following this course I got an audience in almost every case. This change in point of view spelled the difference between complete failure and moderate success. As an engineer, I had wanted to tell the prospect of the mechanical excellence of the machine, and particularly of two electrical tricks I had designed and put on which would stop the machine if anything went wrong, but I found that in order to talk to him at all it was necessary for me to pretend the business man and present the case from a business man's point of view. If I did this successfully he would then allow me to talk to the shop foreman as an engineer, but not otherwise.

Of course, a man's own point of view as an employee — especially if he is just starting out in the business world — will seem quite important to him, but what I am trying to impress upon you is that it is also quite as important that the man learn to look at situations from the executive standpoint of his employer, especially when they relate to his daily contact with those around him and the work he is called upon to perform.

We all realize the importance of punctuality, of keeping our appoint-

NATHAN H. DANIELS, '96

ments, of getting in on time, of starting work on time and perhaps in leaving at the end of the day, but in business there is another angle to punctuality which it is well to keep in mind and that is the importance of turning in your work as soon as possible. Here you are assigned certain work and there is a definite time at which it is due. In business it is usually due as soon as it is finished. Occasionally your boss may ask you to make some special investigation for him. He asks you because he is interested and because he is anxious to get the results. If you turn in the results promptly he gets them before his interest has cooled, and he can therefore make the maximum use of them. The longer you delay the more the matter may have gone out of his mind until your work is of no interest at all. Of course, you may be busy and it may interfere with your routine work to get this special job out. You have the choice of two things: one is to put your routine work aside and give the special work precedence, the other is to wait until the routine work is finished and then take up the special work. Which is the wiser course is a matter of judgment and may depend on circumstances.

I once asked two of my students to make up figures which I was to use in a conference in New York. One man gave me the figures the next morning. I know he must have worked during the evening and into the night to get them out, and as a result of his promptness I was able to study them and make considerable further investigation which the original figures suggested. The second man did not turn in his figures and when I asked him for them he explained he had been so busy with routine work that he had not had a chance to get started on them. Unfortunately I was going to New York that night and had to go without his figures, but I carried a very distinct impression that one man had made good while the other had not.

Educators tell us that a man should be given responsibility in order to develop him. This is true if the additional responsibility is within the man's ability to carry and if it tends to make him think, learn and develop his reasoning powers, but if the increased load exceeds his capacity it may do a man real injury and may possibly cause injury to others. There is a definite responsibility on the employer to see that he does not load the man under him beyond his capacity, but many fail to realize that there is also an obligation on the employee to see that his employer does not overload him. He should know himself, know his capacity, know what he can do safely. If the load exceeds his limit it may become his duty to make his doubts known to the man for whom he is working. I know one employer who is always ready to give the young men under him as much responsibility as they will take, but he holds them strictly accountable for results and he has no use for a man who has not the good judgment to decline responsibility if he knows he is risking disaster. One of his mottoes is, "If you can't catch you have no right to play ball," which is another way of saying the same thing.

Perhaps I can make this point clearer by an illustration. I once had a man working under me whose mind was of the clerical type. He was not quick to recognize new situations, he was not good at analyzing them and determining how they should be handled, but he was good at doing routine work rapidly and accurately. Perhaps a fair description would be to say that he could interpolate but he lacked the power to extrapolate. He would have been a very useful man if he could have recognized his limitations and checked with his superiors when a new problem presented itself, but he felt this would

(*Continued on page 356*)

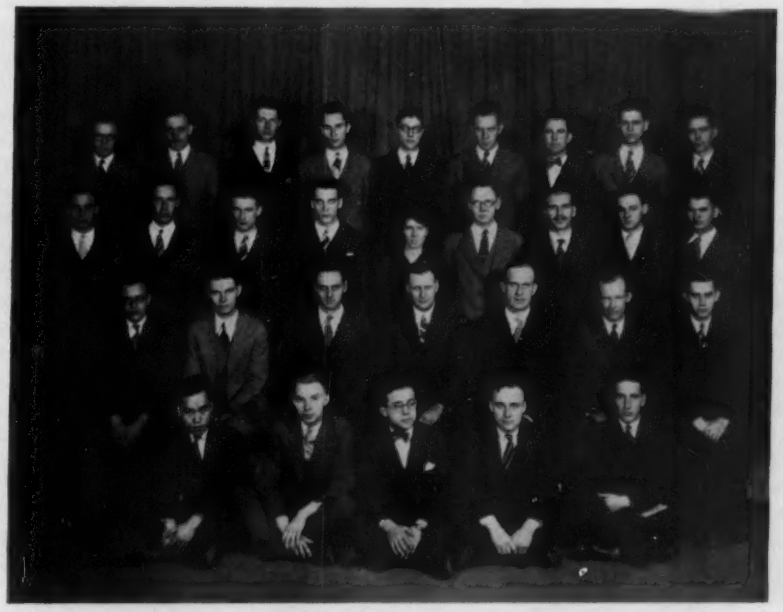
The Research Laboratory of Applied Chemistry

The objects and accomplishments of this division of the Department of Chemical Engineering

By HENRY O. FORREST '20
Assistant Professor of Chemical Engineering
Director of the Research Laboratory
of Applied Chemistry
Massachusetts Institute of Technology

OVER twenty years ago there was considerable discussion in the Department of Chemistry concerning the advisability of conducting research in the field of industrial or applied chemistry. As a result, in 1907 two assistants were engaged to carry on research in technical chemistry under the direction of Prof. William H. Walker, and in the following year the Research Laboratory of Applied Chemistry was organized with Dr. Walker as the director.

Referring to the president's report of January, 1908, we find that "Those Professors of the Department of Chemistry more closely associated with industrial work form the staff in whose care the management of the laboratory is placed. It is at present constituted as follows: Professors William H. Walker, Henry P. Talbot, Willis R. Whitney, Augustus H. Gill and Frank H. Thorp. Dr. Warren K. Lewis, and Dr. William Guerther, have been engaged as research associates and are now devoting their entire time to the problems under investigation. Dr. Peter Burns of the Department of Chemistry is giving a portion of his time to research work and is a member of the laboratory force."



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The initial effort was devoted to a study of the effect of the constituents of steel on its corrosion. It is interesting to note that the laboratory has continued research in the field of corrosion throughout its existence, and at the present time three men are devoting their entire time to this work. Other early investigations included studies of methods for elimination of "gray sheets" in galvanizing and of pin holes in tin plate and miscellaneous problems of interest to the paper industry.

There were only minor changes in the organization and policy of the laboratory until early in 1917 when all the members of the staff became engaged in war work. Reorganization was effected in the fall of 1919 with Professor Walker as director, Prof. R. E. Wilson as assistant director and Profs. H. P. Talbot and W. K. Lewis on the staff. At this time there were seven research associates, two research assistants and two part-time assistants carrying on the experimental work. During this period the laboratory became a part of the newly organized Department of Chemical Engineering.

Thus the laboratory has expanded until at the beginning of the present year there were on the staff, Prof. H. O. Forrest, director; Prof. P. K. Frolich, assistant director, six research associates and twenty-nine research assistants in addition to nine persons on the office and mechanical staff. Such, in brief form, is the history of the laboratory. For the information of many it may be well to discuss the objects of the laboratory and some of its accomplishments.

The two major aims of the laboratory are: (1) Training of men in methods of industrial research and (2) Conducting general research of value to the public as a whole.

In order to achieve the former it is necessary to maintain close contact with industry, and for this reason a large proportion of the research is of a confidential nature for individual companies. Such a policy is necessary also to provide funds for general service research. As conducted at present, approximately sixty-five per cent of the income from contract research is expended in that field, and the remaining thirty-five per cent is available for general research programs. It should be pointed out that the laboratory is essentially self-supporting and that although members of its organization are on the staff of the Institute, their salaries and all expenses, except those for facilities, such as space, heat, light, power, etc., are paid from laboratory income.

The major accomplishment of the laboratory may properly be considered as that of successfully training men for industry. A previous departmental note* has discussed the roles which previous directors and assistant directors have been called upon to fill in various oil companies. Lack of space makes it impossible to discuss the many research associates and research assistants who have left the organization because of splendid opportunities in industry. It is sufficient to state that it is very exceptional when a member of the staff does not find a very attractive opening when he feels that he has obtained the optimum financial as well as technical benefit from the laboratory. The de-

(*Continued on page 354*)

*TECH ENGINEERING NEWS, November 27, p. 269.

Technical Journalism

A description of the opportunities offered in the field of engineering writing

By DAVID O. WOODBURY '21
News Editor of *Power*
McGraw-Hill Publishing Company, Inc.

IN every profession there must be a certain number of people who are able to tell the story of the whole group to the outside world, and to promote within the group the exchange of thought and experience which helps to make the art progress. The engineer, more than any other professional man, has the reputation of being inarticulate, or at least of being so dull and undramatic in his speech and writing that he may even bore his colleagues by what he has to say. Yet the engineer is constantly dealing with dramatic and universally important things, and today more than ever is in need of an interpreter.

As long as the world at large was satisfied to leave the engineer and the scientist alone, they were content to communicate within their own ranks in their own language, and to bury within the volumes of their transactions their discoveries and deductions. But the day is past when it is right, or in fact possible, for the engineering story to lie hidden from the public. The sciences have entered so largely into business and into government that they have come directly into contact with millions of people who have no technical knowledge, but who still have the undisputed right to know at least something of what technical things mean. The people as a whole have signified their interest, too, and it is idle to continue to deny them information on the ground of their ignorance. Great stories lie hidden in science and engineering, and it is in line with the spirit of the times that these stories should become public property.

Because they lacked the time or because they felt it futile, technical men have never made an effort to explain themselves to their fellow human beings, and there has seldom been anyone else properly qualified to do it for them. The result has been unfortunate — bad for the public and bad for the profession, too. Great discoveries and inventions have lacked the public support; great projects have failed to interest those whom they were designed to serve; misunderstanding and misrepresentation, political corruption and large misuse of private power have grown out of the fogs that might have been dispelled by careful and enlightened publicity. Though this is the twentieth century, the scientist is still spoken of as a magician, and his work regarded with awe and sometimes with mistrust. Charlatans and visionaries are still getting the rewards while the real pioneers receive only cordial epitaphs.

In the last few years two things have been done to remedy this situation. First, the newspapers have begun to give space to the scientific and the engineering story, recognizing the drama and real news interest hidden there. Secondly, there has been an amazing growth of what we rather loosely term the trade journal. Only lately have either of these methods of telling the engineering story been handled well, and even now much of the work done is amateurish and inaccurate, and frequently beside the point.

We feel that Mr. Woodbury is particularly well qualified to write on the subject of "Technical Journalism," as he is at present engaged in that calling. After some time in the publicity department of the General Electric Company, he is now News Editor of "Power," a well-known technical journal. As a Technology alumnus who has found his work in the field of engineering literature, his ideas should prove to be of interest to our readers.

And why should it not be? Newspaper scientific stuff is written almost exclusively by newspaper men who have no training whatever in technical matters, and whose normally unerring noses for news are thrown off the scent by the strange nomenclature and the indifference of scientific people. The trade press, while on the whole well enough informed, has been for the most part trivial and uninspired, incapable of rendering the great service which lies before it.

Nor is the whole blame to be laid on the newspaper and the trade publication. They have done the best they could under the existing handicaps. It is the engineering profession itself, it seems to me, which has been at fault in holding itself aloof, continuing in the lofty assumption that what it did was too deep for anyone but its own members to understand. It is even surprising that the news writer has done as well as he has, against the discouraging odds. Even today, when he covers a scientific story, the chances are that he will know nothing whatever of the technical aspects of the case. He will, however, be quick to see dramatic interest, and more than likely in following his natural tendency in this direction, he will at least partially destroy the veracity of his account. Cases of this kind are in evidence every day, in the often ludicrous misstatements that are carried in the press.

Only a few weeks ago, for instance, a nationally prominent newspaper carried a front page full-column story concerning a device which to the trained eye was obviously another perpetual motion machine. Yet the account was given in the utmost good faith, with quotations from supposedly prominent men. Here and there throughout the text appeared statements which any student of elementary physics could have spotted as ridiculous. Yet the account blandly finished with the quoted statement that the new device would soon "revolutionize" an entire industry, making its now expensive product as cheap as water. Incidentally, this word "revolutionize" is a favorite with news men, when they are dealing with science or engineering — the old belief in magic, you see. Yet one never reads of a new law which is going to revolutionize crime conditions, nor of a new method of financing which will revolutionize business.

The engineer, of course, shrugs and remarks that the newspaper reading public would not understand the truth anyway. But that is not the point. The public is going to get the news, wrong or right; journalism is a huge force that must be reckoned with. Does anyone suppose that the reporters would not jump at the real true story if they could get it?

As for the trade press, its principal lack has been that of broad vision. It has written elaborately of gadgets when whole processes were in the making, and of single factories when entire industries were shaping to some new influence. It has been local instead of national; it has adopted the tabloid standard instead of trying to follow through with the less sensational though vastly more significant advances. It, too, needs a housecleaning from within.

The question which I wish to put is: What are we, as engineers, going to do about it? Shall we smile comfortably and say that the whole business is unimportant, or shall we take up

(*Continued on page 342*)

Meteorological Problems and Their Applications

The difficulties of weather forecasting on the basis of exact science

By CARL-GUSTAF A. ROSSBY
Associate Professor of Meteorology
Massachusetts Institute of Technology

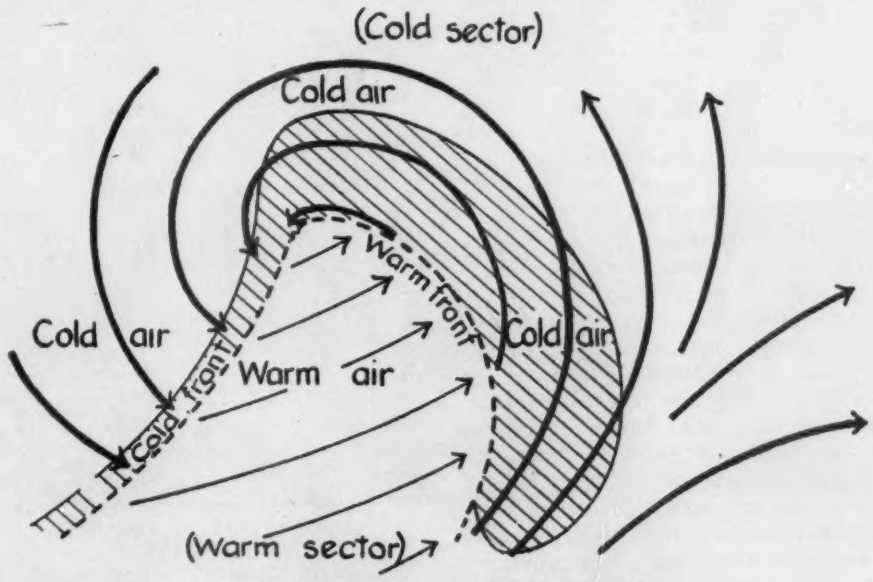
TEN years' work in meteorology have convinced me that the layman usually has a very hazy idea about meteorology as a science. When invited to write an article for this journal, I was, therefore, delighted to have an opportunity of doing some missionary work. However, difficulties which I did not at first anticipate began to crop up.

Meteorology aspires to become an exact science. As such its object would be to calculate, with the well-known tools provided by hydrodynamics and thermodynamics, the state of the atmosphere at any subsequent time, provided it is given at one particular moment. Yet the only completed attempt in this direction, by the British meteorologist, L. F. Richardson, an attempt to compute mathematically the weather six hours ahead of time, required more than a year's work, and was, as a forecast, a signal failure. Thus, so far, the use of mathematical theory in meteorology is confined solely to the explanation of observed conditions rather than to the forecast of future happenings.

The best way of giving the interested outsider an idea of this use of theory in modern meteorology is probably to pick out for discussion one or two of the problems which at present command the interest of those engaged in the field.

One of these problems takes us high up in the atmosphere to the layer between 8 and 14 kilometers. To properly understand the problem, it is necessary to go back in time a few years, to the end of the World War. At that time the so-called "polar front" theory was first presented by Norwegian scientists and rapidly accepted by a number, although not all, of the leading meteorologists. According to this theory, what we call "weather," the sequence of high and low pressure areas, with their attending areas of precipitation and warmth or cold, are the result of a battle between two main currents of air, one originating over the polar region and moving southwestward, the other having its source in the semi-permanent highs over the horse latitudes, from where it streams northeastward. Under stationary conditions, the two currents may flow parallel to each other, the polar current as a cold east wind, the subtropical current as a mild west wind. Between the two currents a sharp boundary will form, appearing at the surface of the earth as a demarkation line between the east and west winds, and from there on extending polewards through the higher layers.

When conditions become unstable due, for instance, to accumulation of too much cold air over the pole, the flight between the currents is resumed. A wedge of cold air may lift a part of the warm and moist current in the height, thus forcing it to expand, cool and precipitate its moisture, or the warm air may descend voluntarily over a cold-air layer, forcing it to retreat.



ANALYSIS OF STORM DISTURBANCE
Typical flow lines of air in a cyclone of northern latitudes, according to Bjerknes.

According to the polar front theory, every cyclone or low pressure area in middle latitudes is the result of such a battle between a northward rushing arm of the warm current, and the cold air. The accompanying illustration, taken from Bjerknes' now classical paper on the polar front theory, gives the details of the cyclonic structure.

The introduction on the weather maps of "fronts," that is, boundary lines between air currents of different origin and history, proved of decided value in forecasting, but the simple ideas of the Norwegian meteorologists concerning the dynamics of the cyclone met with opposition from many sources.

One of the chief objections to the theory arose from certain statistical considerations. In England, Dines had found that at the 8 kilometers level there was a strong positive correlation between simultaneous pressure and temperature changes, with a correlation coefficient as high as 0.95. This result was decidedly embarrassing to the adherents of the polar front theory. According to their concepts, the central part of the cyclone is built up of a warm air current. Hence, low pressures and high temperatures ought to occur simultaneously.

Various explanations were soon offered. Due to the centrifugal forces acting at higher levels in the cyclone, the air in the center is forced out radially. The pressure in the central part of the low will, therefore, drop, and the air is cooled dynamically.

It was soon discovered that this was not the whole explanation. Further investigations revealed that at the still higher levels (14 kilometers), conditions again change. Here a pressure fall may be accompanied by a fall or a rise in temperature, just as at the surface of the earth.

Years ago temperature soundings of the free atmosphere had shown us that at higher levels (above 8 kilometers) the temperature above the equator is considerably below that above the pole. It was, therefore, near at hand to assume that the occasional sudden pressure rises and temperature drops at the 14 kilometer level were caused by cold currents from the equatorial regions. Below each tropical current, say at the 8 kilometer level, the increased pressure from above would cause compression and dynamic treating, in accordance with the results obtained by Dines.

(*Continued on page 350*)

The Single Sleeve Valve Engine

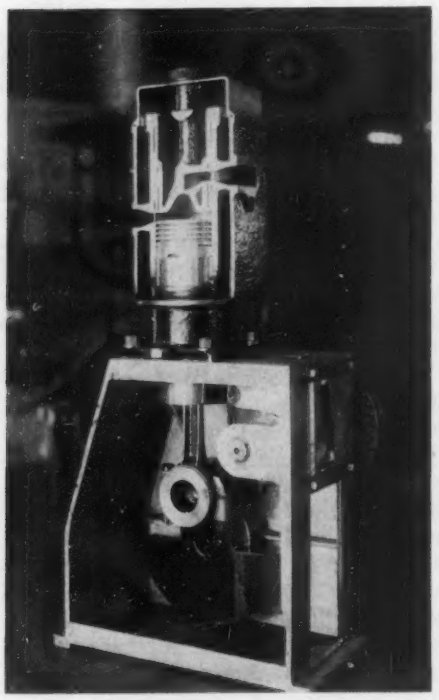
Developed at Technology, it holds promise of many improvements over motors of conventional design

By DEAN A. FALES '14
Associate Professor of Automotive Engineering
Massachusetts Institute of Technology

FOR the past two years the Gaw engine has been in the process of development in the Internal Combustion Engine Laboratory at the Massachusetts Institute of Technology. As the development work has been handled by the inventor and the instructing staff attached to the laboratory its progress has necessarily been slow, as it was not allowed to interfere with the instruction and routine work of the laboratory. It has given both students and instructing staff valuable experience and has aroused more interest than routine work could.

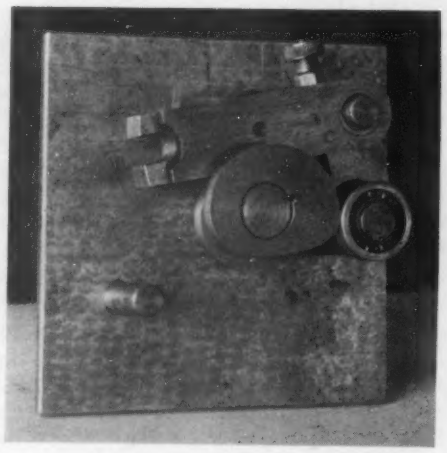
The Gaw engine follows conventional design in the construction of crank shaft, connecting rods and pistons. The difference in construction is in the cylinder block and heads, sleeve valves, and sleeve operating mechanism.

The cylinder block contains the cylinder bores with gas ports and passages and the water jacket. All holes are parallel to or at right angles to the surface of the crank case making the production problem a simple one. The intake ports are on one side of the block and are above the exhaust ports on the opposite side of the block.



SECTIONAL MODEL OF GAW SINGLE SLEEVE VALVE ENGINE

Piston is shown opposite exhaust port, the intake port being above on the right.



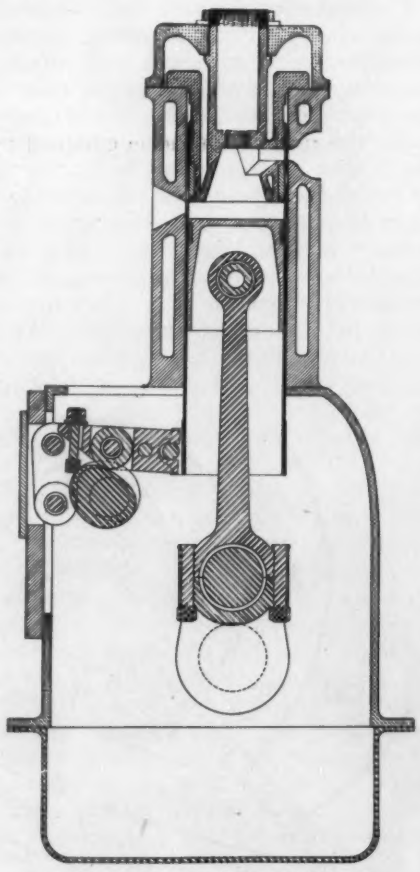
SLEEVE OPERATING ACTION

This shows the arrangement operating the sleeve valve whereby torsion is reduced on the cam shaft.

The sleeves are made of steel tubing with the operating lugs spot-welded onto the sleeve, a construction that has proved satisfactory and one that is adapted to production methods. Each sleeve has horizontal ports cut in it, and these ports come into register with the horizontal ports in the cylinder block at the proper time for intake and exhaust of gases. Due to the horizontal ports and the rapid opening at exhaust, no burning of the ports or overheating of engine parts has occurred. Oil grooves are cut in the outside surface of the sleeves. The single sleeve is light in weight and the lubrication problem is a simple one, as the steel sleeve runs on a cast-iron cylinder wall and can have either an aluminum alloy or cast-iron piston running within it.

A separate head is used for each cylinder. These heads are attached to the top of the cylinder block and project down into the upper open ends of the sleeves. Each head contains a spark plug hole centrally located in the top. Each head contains a port for the passage of intake gas. Above this port is a compression ring (or rings) and below the intake port is a seal ring. The head has a partial restriction below the intake port in the combustion chamber. This gives not only a compact and well cooled combustion chamber, but also one that promotes turbulence. The cool incoming gas sweeps past the spark plug cooling it and maintaining a supply of fresh gas around the point of ignition. The exhaust port is in the cylinder below the head. With this construction the exhaust gas trapped in the cylinder is below the incoming gas and a stratified charge is obtained.

The sleeves are operated by a cam shaft that is located in the crank case and which may be driven from the crank shaft by chains or gears. This cam shaft can be made of a large diameter making it rigid and not subject to torsional disturbance. A pair of positive cams is used for each sleeve or cylinder. Each cam follower or action has two rollers, one roller being in contact with each cam. This action is mounted on a pivot and an arm extends to drive the sleeve. A cylindrical pin is mounted in the bosses on the sleeve, and a slot in the arm of the action engages this pin. To maintain contact of both rollers with their cams, and to care for expansion, a spring take-up is incorporated in each action, but in practice this has been found unnecessary. Both

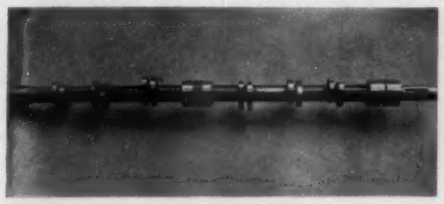


CROSS-SECTIONAL DIAGRAM OF ENGINE

The single thin steel sleeve is lubricated at low speed and light loads by oil thrown from crank shaft and bearings.

ball bearings and plain rollers with bushings have been used. The actions are mounted on the crank-case cover plates which are easily detached and offer large openings to the interior of the engine.

The engine lubrication system follows conventional practice for the crank shaft, connecting rod, piston and cam shaft bearings. The sleeves at low speeds and light loads are lubricated by oil thrown from the crank shaft and connecting rod bearings. At high speeds and heavy loads a valve opens automatically and oil is forced to the tops of the sleeves under pressure and at a measured rate.



CAM SHAFT

Note the large diameter of the cam shaft which insures ruggedness.

Two engines of the same size were built, one being installed in a road test car and the other mounted on a test stand and coupled to a dynamometer. These engines have six cylinders with a bore of $2\frac{7}{8}$ inches and a stroke of $4\frac{3}{4}$ inches. The sleeves are $\frac{1}{16}$ of an inch thick and are made of steel tubing. The weight of each sleeve assembly is 29 ounces. The intake ports are $\frac{3}{8}$ of an inch high with a circumferential length of $2\frac{3}{4}$ inches and the exhaust ports are of the same size.

The engines have a compression ratio of 5.4 to 1 and are operated with ordinary commercial gasolene without any combustion disturbance whatever. When cranked by hand the engines rock back on compression.

The engines have been operated at speeds of over 4,000 r.p.m. but are usually held below 3,500 r.p.m.

The development to date has been largely of a mechanical nature. No extended work on carburetion or manifolding has been done and as the limit of compression has not been reached, it is not considered advisable to publish performance curves.

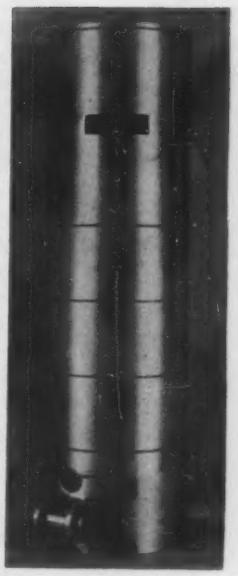
The engine mounted on the test stand has been operated approximately five hundred hours, and of this time approximately fifty hours have been at full throttle.

The road test car has been driven approximately fifteen thousand miles. The car is a five-passenger touring car weighing 2,500 pounds and is driven with the top up and with complete equipment. On a recent trip of approximately 2,200 miles, from Boston to Cincinnati and return, the gasolene mileage was at the rate of 21.4 miles per gallon and the average speed of the run at the rate of 36.6 miles per hour.

The development work to date on the engine has shown the practicability of the Gaw single sleeve principle and the ability of the combustion chamber to function with high compression ratios.

The engine is well adapted to production methods. It is simple, having fewer moving parts than most other four-stroke cycle engines. It is silent in operation and easily serviced. The engine has been shut down after a run, the heads, sleeves and actions removed and inspected, and the engine assembled and run in less than three hours with all the work being done by one man without any help whatever.

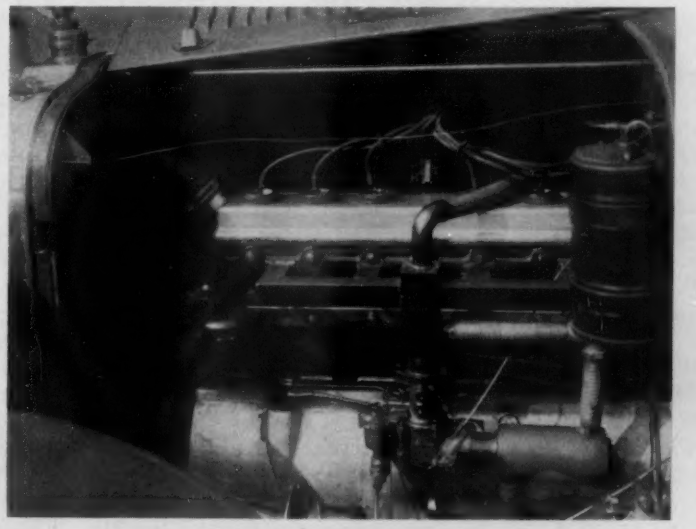
In summing up the advantages of the engine over other types, one of the most interesting features is the combustion chamber with its possibilities for using high compression ratios. The thin light steel sleeves are capable of being operated at high speeds and offer no serious problems in the lubrication or cooling of the engine. The spot welding on of the operating lugs has proved practicable even under conditions where the oil supply was shut off and the engine allowed to seize with no damage. The sleeve operating actions can be simplified. The cam shaft can be made rigid and not subject to the torsional disturbances often found in eccentric shafts with their reduced sections. The whole sleeve-drive mechanism is simple with no intricate machining operations necessary.



STEEL TUBING SLEEVE

The operating lugs are spot welded directly on the sleeve, an operation which readily adapts itself to production methods.

The engines now in existence are experimental models, but with the experience gained in their operation it is believed that a simple, cheap and highly efficient engine could be produced. Many details, however, still remain unsolved, and the development work at the Institute will probably be continued toward this end.



SINGLE SLEEVE ENGINE INSTALLED IN TEST CAR

This engine has been driven 15,000 miles. On recent trip from Boston to Cincinnati and return, gasoline mileage was at rate of 21.4 miles per gallon, and the average speed 36.6 miles per hour.

CRANK-CASE COVER PLATE REMOVED

The sleeve valve operating mechanism and cam shaft are shown here. Note how easily parts can be replaced.

The Central Power Plant in Marine Use

The applications at sea of principles already established in power generating practice ashore

By COMMANDER Q. B. NEWMAN*
United States Coast Guard

THREE causes are responsible for the lag in marine engineering behind shore station practice. The first and possibly the most important is the natural reluctance of the seafaring mind to abandon practices which are known to be good for the adoption of practices which may be better, but which on the other hand may not be good at all. "Inertia," says an old textbook, "is that property of matter in virtue of which external force is required to produce a change in momentum." The inertia of the sea-faring mind is that property, the viciousness of which requires that the external force shall be something tremendous; and determines that the ensuing momentum shall not be such as to imperil anything.

The second cause is the peculiarity of conditions under which marine machinery must operate. The severe limitations of space and weight automatically eliminate from consideration many of the modern shore-station practices. The fact that foundations will be tilted in every direction and sometimes for as much as an angle of 50 degrees, introduces its own complications.

Finally, there is the consideration that if a novelty in a shore station fails to perform according to expectations, only part of the plant is idle, and a telegram to the factory will bring an expert or materials; whereas a ship may be in the middle of the ocean or in the antipodes when her difficulty arises, and she is dependent upon the technical ability and resourcefulness of her engineering personnel.

There are now building in various shipyards throughout the world, seagoing ships whose machinery would have been no particular credit to a designer of thirty years ago; Scotch boilers with an efficiency, as fired, of 50 to 70 per cent; triple expansion propelling engines with a steam consumption rate of 18 to 25 pounds per indicated horsepower per hour (mechanical efficiency unknown and apparently a matter of indifference); single cylinder steam engines or single wheel steam turbines, with a rate of 50 to 100 pounds, for driving auxiliary machinery; and reciprocating steam pumps with a rate up to 150 pounds. One line of steam and exhaust pipes will go all the way to the anchor engine in the bow, and another to the steering engine in the stern.

*Formerly Engineer-in-Chief, United States Coast Guard.

Practical hard-headed men are paying real cash for this junk, and they and their successors will grow peevish trying to get the cash back. Why do they do it? The answer lies in the lack of a sufficient external force to overcome the inertia.

The first serious disturbance to the scheme of things was caused by Sir Charles Parsons when, in 1897, he installed a steam turbine in the *Turbinia*, and demonstrated that a "penny wheel" could drive a ship, and drive her more economically than engines could, notwithstanding that turbine speeds are incompatible with propeller speeds. For a more harmonious plant, Sir Charles later installed a reduction gear, and he still stands by that arrangement.

MAIN CONTROL UNIT

On this panel are the essential instruments regulating the power installations on the new Coast Guard cutters.

Meanwhile Mr. W. L. R. Emmett of the General Electric Company was campaigning for a generator and a motor to bring down the turbine speed to a speed suitable for a propeller; and for many years his arguments were fruitless. Finally the Navy decided upon an experimental installation in the collier *Jupiter*. There are two mysteries still awaiting solution in the case of the *Jupiter;* the first is why the installation should have been considered experimental, and the second is why her complete success should have surprised anybody. But the significant fact was that Mr. Emmett was no longer a prophet, and turbo-electric propulsion was an accomplished fact. To bring this part of the story up to date the airplane carrier *Lexington*, built at Fore River, has recently developed 210,000 shaft horsepower in her eight propelling motors, and her machinery does not approach the limit of a practical marine power plant.

It will be observed that during the thirty years following the advent of the turbine in the marine field, tremendous strides were made in improving propulsion equipment, but corresponding progress was not made, or even attempted in driving auxiliary machinery. Indeed considerable ground was lost, for it was formerly the practice to attach a number of the principal auxiliaries to the main engine and thereby obtain a reasonably efficient drive for them. With turbine propulsion, the auxiliaries had to shift for themselves. Reciprocating steam pumps were used wherever possible, each with one or two steam cylinders taking full steam pressure through the whole stroke. Small independent steam engines were used for driving centrifugal pumps, dynamos, blowers, shop tools, ice machines, and deck machinery.

Lately some of the auxiliary engines have been displaced by small single wheel turbines of such low efficiency that steam is superheated by blowing through them without working; and the gain in economy carries a minus sign.

At this point it is pertinent to remark that information on steam consumption of auxiliary machinery is meagre, and in projecting the machinery for a new ship the engineer is hung up between his own guess and the romantic imaginings of a good salesman. A ship operates as a unit, and it is quite possible for a small prime mover to consume ten times as much steam as it ought to consume, without being suspected.

This brief review of past, and generally speaking present, marine practices brings us to a consideration of the development of a radically new system, which was adapted from central power station practice by the writer of this article. The beginnings of the effort were in 1920, when the first turbo-electric installations in the Coast Guard were being made on the cutters *Tampa, Haida, Mojave,* and *Modoc.* These ships were the first for which a synchronous motor was adopted to

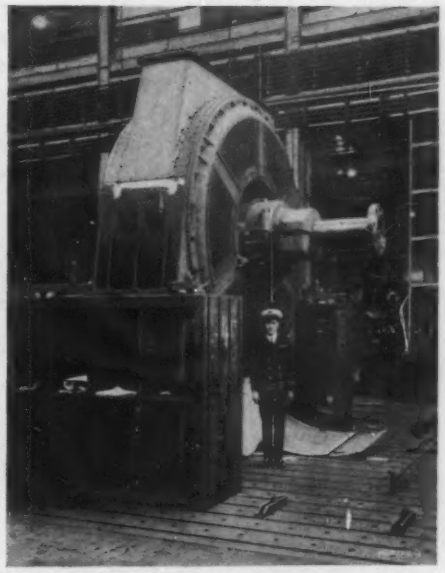
drive the propeller. While their machinery was in process of development, the writer, who was then Engineer-in-Chief of the Coast Guard, proposed that some of the auxiliary machinery be driven by current from the main generator. The General Electric Company, contractors for the machinery, refused for two reasons, which at the time were valid — turbo-electric propulsion in as low power as 2,600 shaft horsepower had never been used, and the synchronous motor was being employed for propulsion for the first time. They argued that it was unfair to allow unrelated problems to influence the success or failure of the new style machinery.

All of the auxiliary machinery for the four cutters was therefore of conventional types, known to be extravagant, but not even suspected of being bad enough to have a marked effect on the whole plant. And so when the four ships of the *Tampa* class failed to live up to expectations as to fuel consumption, it was decided to conduct thorough performance trials of all machinery separately and then of the plant as a whole. Differential and integral experimentation was the idea.

The *Modoc* was selected for the tests and the trials were run in August, 1923. The results were astounding. At full power 32 per cent of all the steam produced was being used by auxiliary machinery, and more at lower powers. In fairness to the auxiliaries it should be stated that they were exhausting against eight pounds back pressure, and that some of the heat in the exhaust steam was recovered in the feed water heater and in the low pressure stages of the main turbine. The results of the *Modoc* trials were presented as a paper before the Society of Naval Architects and Marine Engineers in November, 1923.

There was then a prospect of new ships for the Coast Guard and with the *Modoc* tests for a background, the writer proceeded to Schenectady with the proposition that not only some, but all of the auxiliary machinery should be driven by the main generator when the ship is underway — in short, that the central power station should go to sea. The chief difficulty was the varying frequency of the main generator, which corresponds to the speed of the ship. Naturally, any auxiliary machine driven by an alternating current motor would find its speed fluctuating with the speed of the ship. Such variation would be desirable in the main circulating pump and the fuel oil pump, and possibly not objectionable within certain limits for blowers, fans, shop tools and a few others. It would be entirely unsuitable for lighting, radio, high-pressure centrifugal pumps and refrigeration.

The clue was furnished by the need of direct current for excitation, searchlights and battery charging. The only possibility of obtaining direct current was by means of a motor generator, with an a. c. motor and a d. c. generator, running at speeds determined by the speed of the ship but giving a constant d. c. voltage. If this motor generator were made large enough to drive the constant speed machines, the problem would be solved.



3,000 H.P. MAIN PROPELLER

This 2,300 volt, 3 phase, 60 cycle, 163.5 r.p.m. salient pole synchronous motor serves in the new cutters of the Coast Guard.

The better part of a week was required to canvass Schenectady for the available knowledge on the subject, the apparatus to be employed and the methods of employment; and at the end of the week it was definitely established as a practical proposition. However, the Coast Guard program materialized more slowly than was anticipated, but in 1925 the General Electric Company made a partial application on the Great Lakes ore ship *T. W. Robinson* of the Bradley Transportation Company which thereby became the pioneer ship with this type of machinery. Up to the present writing, anything resembling acknowledgment of the originator is completely lacking.

We come now to the real subject of this article, which is the Central Power Station principle as applied to five Coast Guard Cutters now approaching completion at the Fore River Plant of the Bethlehem Shipbuilding Corporation. Reference has already been made to the expectations of funds for building the ships. The appropriation was made in 1926 and contracts for the machinery were awarded early in 1927. The Westinghouse Electric and Manufacturing Company is the contractor for practically all of the electrical equipment. The propelling machinery consists of the main turbo-generator, 2,500 kilowatts at 3,600 r. p. m.; the synchronous propelling motor which develops 3,000 shaft horse power at 163½ r. p. m.; and the necessary con-

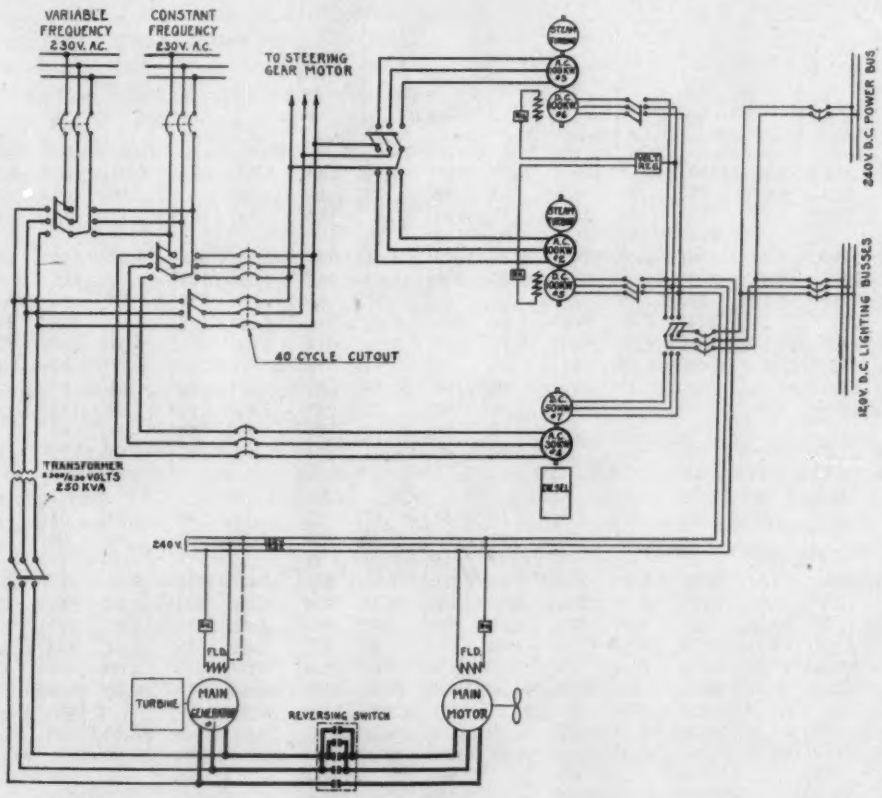


FIG. 1

Schematic diagram of the main and auxiliary power on the United States Coast Guard Cutter *Pontchartrain*.

trol panel which contains the maneuvering switches and speed control. The auxiliary circuit is tapped off from the high voltage terminal of the main generator and is led directly to a power transformer which reduces the voltage to 230. The circuit is led from the low voltage terminal of the transformer to a disconnecting switch and a circuit breaker on the auxiliary switchboard, and from the circuit breaker to the a. c. motor of one of the generator sets previously referred to. A diagram of the electrical connection is shown in fig. 1. An auxiliary steam turbine is connected through a speed reduction gear to the motor generator set and furnishes power to the generator at all times when the circuit between the main and auxiliary systems is open.

The auxiliary turbo-motor generator can be connected to the main generator at any frequency between 40 cycles and 60 cycles. It is, of course, necessary that the two machines be synchronized and in phase at the instant of closing the connecting switch, and a simple means is provided on the synchronizing panel for varying the speed of the auxiliary turbine to suit main generator frequency. The auxiliary turbine governor is actuated by oil pressure supplied by a centrifugal pump on the turbine shaft. In the act of connecting the auxiliary set to the main generator this oil pressure is made to close the auxiliary governor valve entirely. The turbine then absorbs power instead of furnishing power, being driven by the a. c. motor; and the governor oil pump continues to deliver oil at a pressure which varies as the square of the speed. When the speed of the main generator is reduced to 40 cycles the oil pressure in the auxiliary governor system is no longer sufficient to keep the governor valve closed. The valve therefore opens and admits steam to the auxiliary turbine. The opening of the governor valve automatically disconnects the auxiliary system from the main generator, after which the two systems remain separate until the operator again closes the connecting switch.

When the auxiliary system is disconnected from the main system and the auxiliary turbine begins to furnish power, the a. c. motor of the motor generator set delivers power to all of the auxiliary a. c. motors; but when the interconnection is completed, the auxiliary a. c. motors receive their power from the main generator via the transformer. It would, of course, have been entirely practicable to use d. c. motors for all auxiliary machinery, but this would have necessitated a 200 k.w. generator and motor, and the a. c. motor would have been idle at all times when the auxiliary turbine was furnishing power. By making 100 k.w. of the auxiliary machinery a. c., and 100 k.w. of excitation and auxiliary machinery d. c., the sizes of the motor and generator were reduced to 100 k.w. each.

The voltage regulator is the all-important detail of the installation. The voltage output of a generator varies as the speed and the excitation. When the speed is decreased, excitation must be increased and *vice versa*. This calls for a generator which will deliver full voltage at 40 cycles with full excitation and the same voltage at 60 cycles with reduced excitation. The function of the voltage regulator is to fit the excitation to the speed requirements. On the Coast Guard cutters the regulator operates by cutting resistances in or out of the field and is a modification of the well known Tirrill regulator. The operation is dependent upon a pair of vibrating contacts in parallel with a bank of resistance, the coil of the vibrator being connected across the bus bars. When the contacts are closed the resistance is short circuited. If the voltage is low the contacts remain closed for a relatively long time, thereby increasing the excitation. If

(Continued on page 352)

DISTRIBUTION OF STEAM
COAST GUARD CUTTERS *MODOC* (1923) AND *PONTCHARTRAIN* (1928)

		MODOC				PONTCHARTRAIN									
Item		1		2		3		4		5		6		7		8	
1	Run No.	5		8		1		2		3		4		5		6	
2	% of Rated Full Speed	101.0		78.2		101.7		100.0		99.1		78.1		75.5		76.9	
3	% of Rated Full Power	102.1		38.8		106.6		97.8		94.6		39.8		35.5		38.5	
		Steam Lbs/Hr	*% of Total*	*Steam Lbs/Hr*	*% of Total*	*Steam Lbs/Hr*	*% of Total*	*Steam Lbs/Hr*	*% of Total*	*Steam Lbs/Hr*	*% of Total*	*Steam Lbs/Hr*	*% of Total*	*Steam Lbs/Hr*	*% of Total*	*Steam Lbs/Hr*	*% of Total*
4	Feed Pump	1000	2.32	475	2.29	1340	6.72	1045	3.57	1045	3.46	730	4.35	571	4.05	710	4.18
5	Fuel Oil Pump	560	1.29	595	2.88	87	.24	43	.15	39	.13	42	.25	23	.16	24	.14
6	Fuel Oil Heater	.....	.....	120	.58	165	.46	150	.51	140	.47	126	.75	100	.71	113	.67
7	Forced Draft Blower	1540	3.56	.....	.....	244	.68	115	.39	115	.38	.....	.....	.....	.....	.....	.....
8	Total Boiler Group	3100	7.17	1190	5.75	1836	5.10	1353	4.62	1339	4.44	898	5.35	694	4.92	847	4.99
9	Main Circulator	2960	6.85	1370	6.61	389	1.08	215	.73	209	.69	185	1.10	101	.72	123	.72
10	Main Air or Cond. Pump	975	2.25	730	3.52	93	.26	52	.18	52	.17	84	.50	56	.39	64	.38
11	Main Air Ejector	.....	.....	.....	.....	374	1.04	368	1.26	368	1.22	345	2.05	353	2.50	350	2.07
12	Total Vacuum Group	3935	9.10	2100	10.13	856	2.38	635	2.17	629	2.08	614	3.65	510	3.61	537	3.17
13	Lub. Oil Pump	.....	.....	.....	.....	66	.18	41	.14	42	.14	73	.43	52	.37	51	.30
14	Motor Vent. Fan	.....	.....	.....	.....	205	.57	114	.39	108	.36	82	.47	72	.51	80	.47
15	Lighting, etc.	1440	3.30	1460	7.05	301	.84	170	.58	160	.53	272	1.62	115	.82	114	.69
16	Steering Gear	.....	.....	.....	.....	119	.33	55	.19	56	.18	127	.76	58	.41	63	.37
17	Sanitary Pump	580	1.34	710	3.43	91	.25	59	.20	65	.21	109	.65	77	.54	79	.47
18	Bilge Pump	200	.46	320	1.55	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	Steam Kettles	.....	.....	100	.48	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	Transfer Pump	245	.57	165	.80	83	.23	48	.16	51	.17	75	.44	48	.34	51	.30
21	Quarters Vent. Fan	.....	.....	.....	.....	150	.42	76	.21	78	.26	189	1.13	88	.62	95	.56
22	Aux. Condensate Pump	.....	.....	.....	.....	7	.02	7	.02	12	.04	24	.14	8	.06	10	.05
23	Total Miscellaneous	2465	5.67	2755	13.31	1022	2.84	570	1.94	572	1.89	951	5.66	518	3.67	543	3.19
24	Total Boiler Group	3100	7.17	1190	5.75	1836	5.10	1353	4.62	1339	4.44	898	5.35	694	4.92	847	4.99
25	Total Vacuum Group	3935	9.10	2100	10.13	856	2.37	635	2.17	629	2.08	614	3.65	510	3.61	537	3.17
26	Total Miscellaneous	2465	5.67	2755	13.31	1022	2.84	570	1.94	572	1.89	951	5.66	518	3.67	543	3.19
27	Excitation, Main Mach.	4260	9.86	3690	17.81	1275	3.54	789	2.69	808	2.65	1342	8.00	648	4.60	982	5.78
28	Stm. Used on Acct. of Aux.	13760	31.80	9735	47.10	4989	13.85	3347	11.46	3348	11.06	3805	22.66	2370	16.80	2909	17.13
29	Bleeder Stm. for Feed Heater	.....	.....	.....	.....	1822	5.03	.....	.....	2530	8.38	1128	6.72	.....	.....	1435	8.45
30	Stm. Main Turb., Prop. Only	29520	68.20	10983	52.90	29230	81.12	25983	88.54	24332	80.56	11867	70.62	11726	83.20	12636	74.42
31	Total Steam Used	43280	100.00	20718	100.00	36031	100.00	29330	100.00	30210	100.00	16800	100.00	14096	100.00	16980	100.00
32	Leakage	860	.....	767	.....	310	.....	378	.....	320	.....	2249	.....	268	.....	45	.....
33	Total Steam Evaporated	44140	.....	21485	.....	36341	.....	29708	.....	30530	.....	19049	.....	14364	.....	17025	.....
34	Oil/S.H.P./Hr., all Purposes, lbs.	1.195		1.535		.890		.840		.823		1.183		1.079		1.11	

Editorials

AS THE BOARD CHANCES

THE TECH ENGINEERING NEWS is just on the eve of its tenth birthday as Volume IX closes with this, the January issue. We are glad to be able to say that the magazine is at this time in a very healthy condition, and in very good shape to venture forth into the second decade of its existence. Perhaps we, the Managing Board of Volume IX, may point with pride for an instant or two at our achievements of the past year before passing on into oblivion.

The outstanding single issue was probably the May Aviation issue put out at the dedication of the new Guggenheim Aeronautical Building. This was the largest issue on record in many ways — circulation, total number of pages, pages of advertising, and last but not least, financial returns.

The other outstanding achievement was the winning of four prizes at the Engineering College Magazines Associated Convention, where, in competition with twenty-one other college magazines, we were awarded prizes for the best single editorial, the best editorials, illustrations and cover designs. These four certificates hanging on our office wall are an incentive to the work of future volumes.

"Knowledge Plus Wisdom," an article by William E. Nickerson '76 on the need of a Chair of Humanics at the Institute, was perhaps the article receiving the most comment of the year, and when the fall schedules came out there was among the General Studies a course in Humanics. How much of this was due to the part of T. E. N. we do not know, but we like to feel that we had some small share in the work of getting the new course.

The number of orders for reprints of articles during the year was a very healthy sign that the authors of articles really meant what they had to say, and wanted to make further use of the articles in various ways. Likewise a healthy sign was the number of times the issue was sold out completely. Copies of the February, April and October issues are now at a premium, and we do not have enough of these numbers available in the office for our own use.

There have been few radical changes this year, the only noticeable one being in cover design. Though we won a prize with the old cover, we feel we have made still more improvement to gain one which better suits our desire for simplicity and effectiveness.

The business department, though seldom heard of in the editorial columns, surely deserves commendation for its work this past year. Though T. E. N. has always been sound financially, Volume IX has been safe by a large margin, and the state of the books has been one of which any organization could well be proud.

And now, with our work all finished, may we present those who follow, the Managing Board of Volume X, and with our best wishes for success, may they creditably uphold the traditions of THE TECH ENGINEERING NEWS: Charles C. Ladd, General Manager;

THE COVER

Through the courtesy of the Schwartz Calleries, we have been permitted to use Mr. O. Kuhler's etching, "The Power House," for the cover of this issue. It is but one of this artist's numerous presentations of scenes familiar in our industrial life, embodying and expressing the spirit of the part of engineering in our modern civilization.

Howard S. Gardner, Jr., Editor; Charles F. Edlund, Business Manager; Irvin R. Mitchell, Managing Editor; Nelson B. Haskell, Advertising Manager; Richard T. Kropf, Circulation Manager; Christian E. Grosser, Associate Editor; Charles R. Wood, Publicity Manager; and Anthony B. Savina, Treasurer.

EFFICIENCY IN STUDY

A major purpose of the technical education is to acquire a knowledge of efficiency as applied to industrial methods and equipment. The problem of acquiring the education efficiently is a vital one deserving of the deepest consideration from school and student.

We have no doubts concerning the efficiency with which the courses are presented to the student at Technology — in the lectures, in the classroom recitations, and in the textbooks. This is a matter which is handled in the most approved manner and contributes considerably among the causes which make our school one of the best in the world.

However, the question may be asked — how many technical students utilize that time which is devoted to preparation to the greatest possible advantage? We venture to say that very few, especially among the first and second year men, are cognizant of the most efficient methods of study. Except in the few cases where means were provided in the preparatory education, the student has no way pointed out to him by which he may do the most efficient studying.

Dr. Charles W. Eliot, former president of Harvard, once stated that "The most important step toward getting mental power is the acquisition of a right method in work." Dr. Eliot did not believe the students, unguided, would stumble into good habits of reading, thinking and studying. Unfortunately, few of us have learned the proper method of study. We blunder along from day to day, leading a sort of hand-to-mouth existence, falling behind in one course in order to concentrate on the more immediate and pressing problems of some other subject. Only when we have learned how to plan our time wisely and to utilize that time in such a way that we derive the maximum benefit, can we say that we have mastered the secret of efficient study.

THE MAN AND THE COURSE

In liberal institutions, where each student can choose for himself a number of those courses which he wishes to take, there seem to be certain ones overwhelmingly the favorites, not necessarily because of the particular value of the subject in later years or the fact that it can be passed with a minimum of effort on the part of the student, but because of the reputation of the man giving the course. In this case, the ideas, the personality of the lecturer are worth far more than the mere knowledge the student may acquire.

Here at Technology we are not as fortunate in having a wide latitude in our choice of subjects. We register for a particular branch of engineering, and from then on, the nature of our studies is rather arbitrarily outlined. We do, however, have among our courses those in which the instructor, rather than the subject, is the dominating factor. His lectures are colored with personal experiences which give the student a glimpse of the professional field he hopes some day to enter. The subject seems alive and interesting, and one's initiative can be followed to a better understanding of its depths. The student feels that here is a true engineer, the kind of professional man that he aspires to be, and each lecture or recitation can be an inspiration in itself.

To wish for an entire faculty of this kind of man would be to ask for a Utopian condition, but we can feel ourselves fortunate that so many of these men are numbered among our teachers at M. I. T.

The Engineering Field

Abstracts from the leading professional and trade journals

A Concrete Carrier Truck of new design which not only agitates the concrete but also mixes the separate ingredients while transporting from a central plant to the location of construction is a late development in the engineering field. It differs from the type of carrier in which a premixed concrete is merely agitated to prevent its settling during transportation.

The truck consists essentially of a cylindrical tank placed on a heavy chain. Within the tank are rotating arms actuated by the truck motor. The arms act in a worm screw fashion and are very effective in mixing the contents of the tank.

At the central plant the water, sand, cement and gravel in correct proportions are poured in through openings in the top of the tank. Upon arrival at the job the finished mixture is poured out through a gate at the rear.

Ready mixed concrete is fast superseding the type which is produced by the contractor directly at the scene of building operations. The main reason for this is the greater ease with which specialists in concrete production can maintain standard mixes according to specific formulæ.

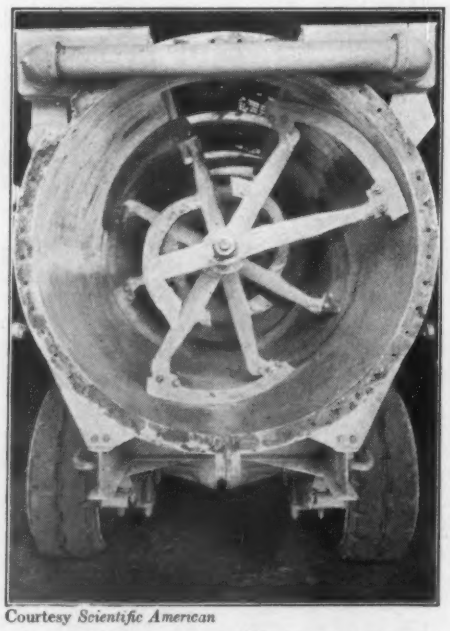
Armature Bearings in the motors of a western public service company are being electroplated to increase their size to fit worn motor housings. When housings became worn, the old method of repair was to rebore the housing and use an oversize bearing, or if the housing bore was correct, to discard the bearing entirely.

After the bearing has been brushed, polished and cleansed in acid and then rinsed in clear water, it is suspended from a copper bus bar and submerged in a plating solution, and on the other pole, which is the anode, is placed scrap copper. The current used is 250 amp. at 6 volts, and the plating is done with great accuracy. The bearing is then washed, polished and assembled in the housing.

This electroplating process is economical and much simpler than the reboring process.

Slotted Wings, for increased safety of airplanes, have been under development for many years and have lately come into vigorous consideration. A few planes, equipped with the new wings, have been imported into this country, occasioning great interest.

The slots, applied to the leading edge of the wings, greatly increase the wing area. This gives a better control of a plane in trouble by increasing the maximum angle of lift and giving a longer postponement of the stalling point. When first made, the slots were constructed the whole length of the wing and were hand-operated. However, this was undesirable because when a pilot found himself in trouble he would forget to use the slots, and so the slots were useless when they were most needed. Recent experiments have perfected an automatic operation of the slots which greatly increases their value.



Courtesy Scientific American

REAR VIEW OF THE CEMENT MIXING TRUCK

The advantages of this slot device are difficult to estimate. Maneuvers may be performed which were not possible otherwise, but many experienced pilots prefer to fly planes without slots. While a plane can be controlled better beyond the stalling point, it is thought that with the extra control it becomes more dangerous with the slot device.

Theory and practical applications require considerable further development before it will be universally accepted among manufacturers and operators of modern types of planes.

A Gas-Pressure Regulator has been recently introduced by an eastern company to regulate the pressure of large volumes of gas and control the operation of gas outlets.

Equipped with a safety blow-off valve and two pressure gauges, it can be subjected to severe usage. The floating monel metal operating pin resists corrosion without sacrificing tensile strength, and the spring closing the regulator instead of acting against the gas pressure acts with it. The whole regulator is enclosed in an exceptionally sturdy casing.

1300 Miles of Track are to be electrified by the Pennsylvania Railroad Company within the next seven or eight years at the expenditure of $100,000,000. This immense electrification project will be far more important than that of any other railroad in the world in the extent of the track to be electrified, in the amount of new equipment, in the immensity of the business handled, and in the number of trains which will be affected.

The electrification will progress in sections starting with the road between Philadelphia and Trenton, to be completed in 1930. Transmission of power will be by the overhead system and not by the third rail, although in some places both will be used. The number of electric locomotives required for the project will probably run up to several hundred. Countless new engineering problems will be involved in the enormous project.

The apparent reasons for the electrification are the greater rapidity of freight and passenger service which will result as well as increased economy of traction in heavy traffic.

Spectrographic Analysis is now being used for qualitative and quantitative analysis in many technical laboratories. The high degree of sensitivity and the ease of the analysis make it especially valuable for detecting small amounts of metals in alloys.

A specimen to be tested is made into an electrode if possible, and a spark vaporizes enough of the substance to make a photograph of the spectrum. In this manner analyses may be made without harming, to any noticeable degree, a valuable specimen. Quantitative analysis is possible through making a graded series of photographs representing varied amounts of the material being analyzed for and comparing with it a spectrogram of the unknown. Up to a certain amount the line intensity is directly proportional to the amount of the element and the varying sensitiveness of the many lines make this a very accurate method of determination which should assume an

important place in technical laboratories.

A New Unit Humidifier has recently been designed by a Michigan manufacturing concern to be used in conditioning the air of one room or a small space. A battery of units will handle an entire building, regardless of size.

Operation of the unit is completely controlled by automatic apparatus, and when connected to a cold-water supply can be used as a cooler and dehumidifier.

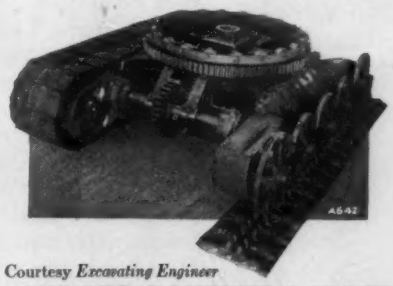
This new humidifier unit is claimed to be economical and flexible in operation, easy to install, easy to move, and is suitable for use in old buildings without costly alterations.

A Cofferdam, used in constructing the raw water intake for a southern mill, was designed with truss-timbered ring bracing so that no bracing would pass through the concrete walls of the intake.

Designed as a true circle with a radius of eighteen and a half feet, each three timber ring brace was constructed of timbers 10 in. x 10 in. in cross-section and bolted together by ¾-in. and 1-in. bolts with iron plates used for connection between the struts and waling members.

Three of these rings were made, each weighing six tons. The first ring was centered in place above the water level, and eight wood guide piles, 25 ft. long, were driven inside the ring and against the timber circle. The second ring was placed 8 ft. above the first one, and one hundred and two steel piles, specially greased, were placed about the rings. The third ring was then put inside the steel sheeting. As the inside of the cofferdam was excavated the rings gradually lowered themselves while the steel sheeting cut right through the earth.

The cofferdam, thus built, allowed to be constructed within it without obstruction a 14 ft. x 12 ft. intake, which has proved stable under all flood conditions.



Courtesy *Excavating Engineer*

CATERPILLAR MOUNTING OF THE ELECTRIC SHOVEL

A New Grinding Machine has been developed by means of which forgings or castings may be ground from the rough in one operation. Work-holding chucks are mounted on a large circular fixture which revolves, carrying the work across the abrasive wheel. As each chuck is moved to the grinding wheel it is rotated on its own axis by the power of its individual motor, mounted on the rear of the work fixture. After each chuck leaves the abrasive wheel it ceases to rotate.

There are eight pneumatic chucks in all. The one at the abrasive wheel and two others revolve, the other five being stationary. As each chuck leaves the abrasive wheel it is stopped by a brake after the power actuating it has been turned off.

The work pieces are unclamped automatically as the chucks leave the abrasive wheel, facilitating substitution of an unfinished piece for the finished one. The new one is automatically clamped in the chuck before it reaches the grinding wheel.

The abrasive wheel, of the segmental type, revolves on roller bearings and is fed forward from time to time to compensate for wear. An indicator arm helps the operator to judge how much to move the wheel, and a graduated hand feed facilitates accurate feeding of the wheel to the work. Due to the construction of the machine it is possible to have the wheel cut lightly as it leaves the work, thus producing a smooth finish.

One of the chief advantages of the machine is that a skilled operator is not required, the manual work being mainly to remove the finished pieces of work from the chucks and putting in rough work.

Electric Shovels of a new type are attracting considerable attention by reason of the ease and economy of operation as well as increased capacity over the steam shovel of the same size. Their introduction into such fields as coal mining and quarrying has resulted in greatly increased production accompanied by raised efficiency of operations.

Among the unusual features incorporated in the new shovel is the elimination of clutch and brake in the hoist machinery. Regenerative lowering of the bucket is substituted which provides smoother and faster operation, and gives absolute control to the operator. This arrangement also reduces the net power consumption. Separately excited motors of the direct current type are used, providing the greatest flexibility of

Courtesy *Excavating Engineer*

THE NEW ELECTRIC SHOVEL IN OPERATION

operation. All the machinery is readily accessible and practically arranged. Power is supplied at a potential of 4,000 volts.

Where the duration of a job warrants an electric installation there are many advantages to be derived from its use. Steadier operation with no standby losses, greater freedom from repairs, absence of vibration, and the elimination of the necessity for boiler cleaning are the chief considerations to be taken into account.

A Sign Carrier Airplane has recently been introduced by an eastern corporation to furnish aerial advertising by means of neon tubes placed under an exceptionally large lower wing. The plane is claimed to be the largest commercial biplane now in existence, and several others are in the process of construction.

The span of the lower wing is 90 feet and under it are placed letters illuminated by tubes of Claude Neon gas. Eighteen six-foot letters are spread across the wing, and a second set of eighteen other letters may be superimposed alternately on the first letters, giving a possible advertisement of thirty-six letters. Power to illuminate the neon tubes is produced by dynamos which give a current of 7,000 volts, and transformers are also located on the wings. In order that the operator may know that all the letters of the sign are illuminated, special light-tubes are placed on the trailing edge back of the letters they represent.

Loud Speakers have lately been installed in convenient locations throughout an aircraft plant.

When a certain man is wanted, he is called through the loud speaker in his department. If he is not there, a general call is put through.

The arrangement enables officials to talk with any employee without having to see him personally.

Departmental Notes

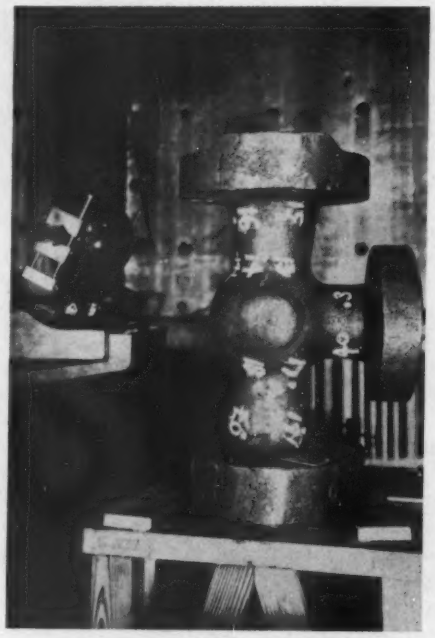
DEPARTMENT OF PHYSICS

The usual custom of the Physics Department of inviting lecturers from abroad has been followed this year, and Dr. Werner Heisenberg, Professor of Theoretical Physics at the University of Leipzig, will be here for some time during the second term. Professor Heisenberg will deliver a series of lectures on the Application of Quantum Mechanics to the Theory of Chemical Valency and Ferromagnetism. He will also give one lecture on the Principle of Indetermination. A detailed schedule of the lectures will be published soon.

Professor Hardy has completed the development work on his color analyzer, and arrangements have been made for its commercial production by the General Electric Company. It will soon be available for the general analysis of color. One of the first examples of the commercial device was recently exhibited at the Washington meeting of the Optical Society and attracted much attention and favorable comment. The laboratory staff is now going on with the research on the general study of color for which the instrument was invented.

Prof. John T. Norton and his staff in the X-Ray Laboratory have been devoting a good deal of attention for the last few weeks to the study of defects in the large steel castings which go to make up the valves and fittings of the modern high pressure steam plants. The particular purpose of this investigation is to aid the makers of steel castings in preparation of these very difficult fittings. It seems pretty clear that one of the limitations of high pressure steam work is going to be, for a time at any rate, the valves and fittings which are needed for pressures of the order of 1600 pounds or more.

In the Acoustics Laboratory Doctors Barss and Frank have recently installed a very effective equipment for the quantitative and qualitative analysis of sound, and for accurate determination of the transmission of



CASTING BEING X-RAYED

Large steel castings are being constantly subjected to X-Ray examination in search of internal defects.

sound through building materials. They have been devoting some attention to the study of noises and sounds which occur in the city streets as a result of traffic and other disturbances.

The development work which has been carried on for some years by the head of the Department and several associates to develop a refractory material of superior resistance to heat and load has now resulted in the establishment of an industrial plant for the manufacture of this material. A second plant for the same purpose is now being built in Georgia.

Dr. Stockbarger has continued his studies on ultra-violet radiation, and is now constructing a most ingenious machine for determining with great rapidity and accuracy the percentages of ultra-violet radiation present in the light from any given source, natural or artificial.

Dr. Knobel is continuing his work on the protection of steam producing plants from internal corrosion, and the laboratory experiments which have been going on for more than a year are now being checked by actual experimentation in one of the great near-by power stations.

Professor Frost is continuing his photoelastic study of airplane structures, and has an unusual number of graduate students working on problems of this type. The study of the design of monoplanes is receiving the major part of the staff's attention at present.

Prof. Hans Müller and his associates are busy working with the relatively new Raman effect, a phenomenon concerned with the alteration of the wave length of a beam of light when passing through liquids, which bids fair to be very helpful in substantiating some of the modern theories of radiation. They are also continuing their study of dielectric phenomena with particular reference to the construction of electric cables.

Professor Wilkes is studying some of the latest types of absorption refrigerating units, and has recently been engaged in measuring the heat transmission characteristics of some new and very efficient high temperature insulators.

Professor Young has just been investigating the extent and causes of the vibration of some industrial buildings.

Professors Drisko and Page are devoting a considerable amount of time to a revision of the course schedule to take care of the increased call for men trained in Industrial Physics. It is becoming constantly more apparent that the principal field of work of the graduates of Course VIII lies in the industrial research laboratory rather than in the teaching field. Much of the industrial work so-called is not at present of any practical application, but is of a theoretical type. However, many of the large industries are systematically supporting research of this sort, and are finding it a very

(*Continued on page 350*)

VIEW OF PHOTOELASTIC LABORATORY

On the long table is set up the apparatus for analysis of stresses by the use of polarized light

You can be a Key Man later, too

The world confers its key positions on many men. It must. There is more than enough important work to be done.

Here is the man with the bent for machinery; he is building a career for himself as a designer of ingenious almost-human automatic machinery for making the nation's telephones. Here is the analytical man with the mind for figures; he is discovering for himself and for industry what miracles lie waiting to be found in unexplored statistics. Here too is the born leader; delving deeply into personnel relations to emerge with the solution for a vital management problem.

In the processes of telephone making, many a broad general qualification is being shaped into a highly specialized and highly important "key" quality.

Western Electric

SINCE 1882 MANUFACTURERS FOR THE BELL SYSTEM

Recent Books

This department conducted in co-operation with the faculty

The Nature of the Physical World. By A. S. EDDINGTON, M.A., LL.D., D.Sc., F.R.S. *The MacMillan Company, New York. 361+xvii pages. Price $3.75.*

This book contains, with slight changes, the material that was delivered to the University of Edinburgh in the Gifford Lectures during the period between January and March, 1927. The theory of relativity, the new quantum theory, and other progress in the discovery of scientific principles have brought about great changes in scientific thought. It is of the philosophical outcome of these changes that Professor Eddington treats in this book. The author's aim has been "to make clear the scientific view of the world as it stands at the present day, and, where it is incomplete, to judge the direction in which modern ideas appear to be tending, and to discuss some of the results of modern study of the physical world which give most food for philosophic thought."

The first eleven chapters discuss chiefly the newer physical theories, their underlying principles, and the reasons for their acceptance. In this group are found: treatments of relativity; time; the running-down of the universe; the law and explanation of gravitation; man's place in the universe; the quantum theory; the new quantum theory; and world building. Although these chapters are worth while, purely as discourses on the various modern theories concerning physics, they have been developed with special reference to their philosophical aspects and possibilities. The following have been treated in the last four chapters of the book: pointer readings; reality; causation; and science and mysticism.

In writing the book, the author has adopted a remarkable style. In a scientific book, and this is certainly a scientific book in material if not in manner, one usually expects to find a formal manner of fearful concentration with rigid proofs of perfect mathematical exactitude. This book is almost conversational in its style, making for more personal and more colorful reading. Its very informality is invaluable in helping the reader to accept the multitude of intangible conceptions without feeling distraught at the impossibility of visualizing the ideas, or of finding physical analogies to help in grasping them. Even when the ideas which the author wishes to express become comparatively complicated, his style does not become more involved or more difficult. When everything is variable, when little is absolute and nearly everything is relative, when there is nothing that is tangible in this scientific symbolism of the work-a-day world, it is pleasant indeed to find as easy, uninvolved, and yet accurate treatment of the field of modern physical conceptions. It is to be remarked also that the use of equations, the clearest means of conception to the scientific mind, has been practically forgone.

The book covers a remarkably large range of subject matter. Bearing in mind the contents of the book — relativity, the quantum theory, and the others, all subjects of some depth — it is not surprising that the treatment of each is necessarily brief and cursory. This, however, is not condemnation since, as the author intended, the philosophical aspects have been well brought out through the whole work.

The book is unquestionably worth reading, especially for those who wish a more general view of the progress in the field of physics in late years rather than a specialized and exhaustive treatise on one subject. Added to this, of course, are the philosophical conclusions which form one of the ultimate purposes of the work.

J. P. R., JR.

Fixation of Atmospheric Nitrogen. By FRANK A. ERNST. *D. Van Nostrand Co., Inc., New York City, 1928. 154 pages. Illustrated. Price $2.50.*

As a member of the staff of the Fixed Nitrogen Research Laboratory, and from his former associations with the Nitrate Division of the Army Ordnance and the American Cyanamid Company, Mr. Ernst is well qualified to write upon his chosen subject. His aim has been not to present a highly technical work for one already familiar with the field, but to furnish the layman having a certain amount of general scientific training and interest with a comprehensive survey of the situation.

He creates a background through the introduction of a discussion of the various natural and industrial sources of fixed nitrogen, and describes in detail the history of the experimental work in the fixation of nitrogen from the air. The increasing demand for fixed nitrogen is analyzed, and the methods of satisfying this need are discussed in turn.

Although it could probably supply the world for a century to come, Chilean nitrate suffers from the competition of industrial sources of fixed nitrogen, and it has ceased to be of primary importance in the world supply. Both by-product ammonia and fixed atmospheric nitrogen now exceed it in annual production. By-product ammonia, however, is dependent upon the production of coke for its volume, and Mr. Ernst turns to the fixation of nitrogen from the air as the chief source of this element.

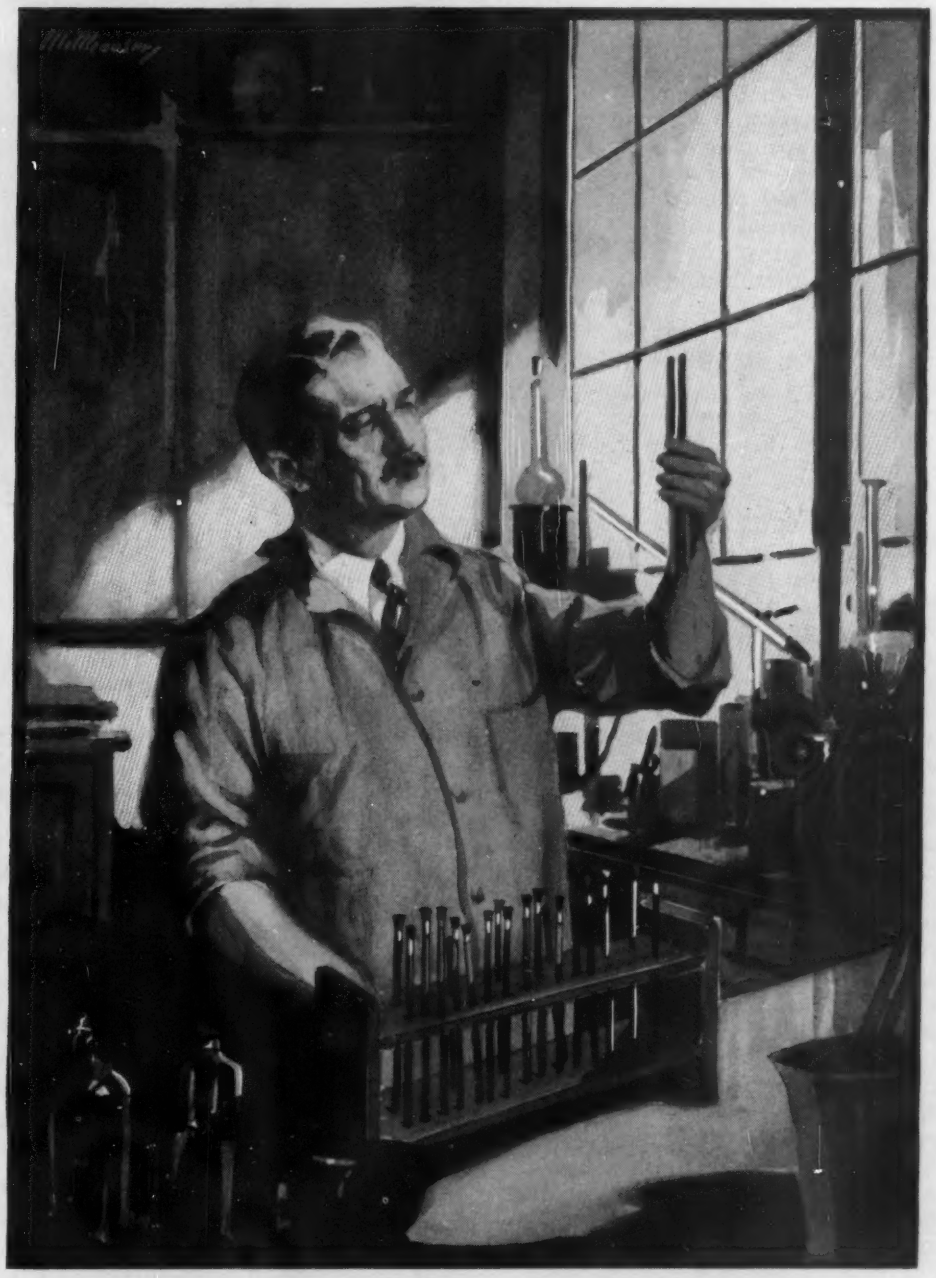
Of the three processes now in use, the arc process, cyanamid, and direct synthesis of ammonia, the latter seems to be the most important both in the volume of its production and in the plans for a future supply. Each of these methods is fully treated from an engineering standpoint, and both the chemical and mechanical features are developed in detail. Much valuable operating information is furnished with regard to the leading plants in various parts of the world.

Since the economic considerations form an important part of the production of any commodity, they receive due attention in this case. It is pointed out that little can be done to lower the price of Chilean nitrate, and that with the shift from the other forms of nitrogen fixation, the industrial method can do more than compete favorably with the natural source. Tables of comparative costs and numerous statistics serve to provide all essential information in regard to the past and present world supply.

At present Germany is fixing the largest annual amount of nitrogen and her fixation industries are constantly expanding. In the United States a few plants are working on a small scale, but nothing can be said to approach the magnitude of European operation. Within a few years, however, it is expected that plants will have been erected and processes installed so that America, too, will render a considerable contribution to the world's supply of fixed atmospheric nitrogen.

In conclusion, we may say that the book covers the subject of the fixation of nitrogen in a very satisfactory way. It deals with both the engineering and economic phases of the question, covering the subject thoroughly from the layman's standpoint. At the same time, it contains information which is sufficiently technical to be of value to those already familiar with the topic. In case one's interest has been aroused, and more detailed information on some phase of the subject is desired, a well-planned bibliography points the way to further reading.

H. S. G.



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Lead the metal goes into bearing metals, solders, roof flanges, sheathing for electric and telephone wires, pipes and fittings. Lead compounds make paints, paint pigments, oxides for many industrial uses, and for protecting all surfaces from wear and weathering. Everything painted, every machine that runs on bearings, every home, almost every industry benefits from the skill of the industrial chemist who is constantly at work perfecting the uses of lead.

Lead and zinc flow sheets are available *free*—also other valuable data on lead and its products for class room use. Write *The Eagle-Picher Lead Company, 134 North La Salle Street, Chicago.* Eleven Plants. Branches in all principal cities.

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Producers of Lead and Allied Products

Technical Journalism

(*Continued from page 328*)

the problem with the same clear and dispassionate power of reasoning which we use in the spanning of a great river or the improvement of a power plant's efficiency? The answer is already written, for men of vision in the profession and out of it have already realized the situation and have begun the campaign.

Obviously it is a situation which must be met mainly from within the profession. Literary and newspaper men have not the technical background, and no matter how good they may be as writers, they lack the one essential — the ability to appreciate the true bearing of the facts. Admittedly, engineers are not good writers as a class, and admittedly, also, they are extremely busy doing important things. But the same may be said of doctors and shoemakers and airplane pilots. Yet from every trade and profession have come men of talent and even of genius in journalism and literature. The sciences have perhaps produced fewer of these than other walks of life, but that does not mean that there is not good material within their ranks.

In every technical school there are students who show ability to write. Otherwise there would be no undergraduate engineering magazines. These men are all headed for some branch of science or engineering, and it is from among them that the technically trained literary forces must be recruited. The technical undergraduate would feel insulted, perhaps, if it were suggested that a career worthy of his consideration lay in technical journalism or in scientific newspaper writing. He would tell you that writing was all very well on the side, but he would treat lightly the idea of entering it intentionally as a life work. He would point out that the men already in the game had got there because for some reason they were unsuited to the practice of engineering. And he would scorn what he considered a career of standing on the side lines singing hosannahs to the other more active group which was turning out the real work. Ten years ago perhaps he would have been quite right in all this. The broken-downs and the also-rans certainly did find a comfortable haven behind editorial desks. But that is not so much the case today, and it is going to be far less the case tomorrow. To make it so, the literary profession is going to draw its material from among the undergraduates who are even now showing a marked though deprecated ability to write of technical subjects with real ability and understanding.

The young engineer often feels that in the natural course of his professional work he will get plenty of opportunity to publish his ideas in society journals and in books — he says that they all do. The trouble is, however, that they all don't, and many of those that do publish their work are making a sad job of it, at least from the literary point of view. The technical man has no call to contend that being literary is none of his business. Literature is not so much the expression of things beautifully as it is the expression of things *well*. Much of the writing in technical books and magazines is not even good of its kind, and that, I think, should constitute an incentive, even to the practicing engineer, to do better.

Unfortunately, writing is not to be "picked up on the side." It is just as much of a profession as engineering, and furthermore, it is an art, not a science, and thus is not accomplished by formulas, nor turned on and off as occasion requires, nor controlled with the same accuracy and deliberation as a problem in quadratic equations. It is not the compilation of reports on blank forms, but the expression of ideas in a language quite as complex as mathematics itself. Strangely enough, few engineers realize this. Though they are so strong for going directly to the point and for putting the fine edge of efficiency on everything, they seem to enjoy winding themselves up in complicated sentences and paragraphs, often becoming shockingly verbose and even vague and ambiguous. They usually say in twenty words what a poor untutored newspaper man could put in ten if he only knew what to say.

Thus, whether the undergraduate engineer looks kindly upon a literary technical career, or intends only to practice his profession as he learns it, it is important for him to train himself as much as possible to express himself in good, plain, understandable English. If he never has occasion to address the public, he will at least be called upon to tell his fellow engineers what he is doing, and it is important that he make himself not only understood, but interesting and convincing. This means literary training.

Sooner or later the recruiting of men for the engineering literary job will become a definite part of the broad subject of engineering itself. It will no longer be, as it is at present, a hit-or-miss proposition. The men who have drifted into the game by chance will be replaced by those who have chosen that work from the first and who have carefully nursed their special talents so as to make the combination of them strongest and best adapted to the work that is to be done.

I have suggested that these trained engineering writers will be drawn from the ranks of the regular technical graduates, and for this there are good precedents already set in other fields. It has been shown in the last few years that business executives and salesmen connected with engineering firms benefit greatly from sound technical training. Many large companies are even requiring that both of these jobs be filled by engineering graduates alone. The older idea was that a good executive could boss any business, or that once a salesman always a salesman, no matter what the line of goods. But a careful analysis shows that certain qualities are inborn, while others may be trained into a man. Thus the ability to command or to sell is possessed from birth, but is admitted to be of doubtful value unless its possessor is also trained to use it in some particular line of work. Engineering, being a good deal a matter of a trained mind rather than a developed talent, is therefore an admirable support for native ability of an executive or sales nature. The talent for writing falls in the same class, and cannot be acquired to any appreciable degree after birth. But within limits you can train a writer to be an engineer or a doctor or a botanist, and profit doubly accordingly. And so, with "management engineers" and "sales engineers" already accredited and provided for in graduate curriculums and in industrial training groups, what could be more fitting than to provide a similar opportunity for those with a flair for pen pushing?

Our technical schools have not as yet put this idea to a practical test except as they encourage undergraduate journalism, which is no more than a start. On the assumption that they will carry the idea further as time goes on, let us examine the opportunities in the technical journalistic field which await those who have made the decision to follow writing as a profession. Roughly speaking there are three, or at most four, divisions in this engineering-writing field. They are: industrial publicity, trade and technical journalism, semi-scientific writing for the press, and freelancing in popular science. Of the four, the first two are "safe and sane" and provide the best experience. The third is difficult to get into except on the strength of a big reputation or long years of newspaper work, and the last is by far the most interesting. Free-

(*Continued on page 344*)

The PRESSURE GAUGE

OF the thousands who use Hercules Dynamite daily, comparatively few realize that constant tests must be made in order to maintain the high standard of quality set for this product.

In one of the laboratories of the Hercules Experimental Station at Kenvil, N. J., stands a massive steel cylinder with a door at one end resembling the breech block of a 12-inch gun.

This machine—the pressure gauge—provides one test for determining the strength of an explosive by accurately measuring the pressure of the gases developed when a small charge is detonated within its cylinder.

The gases are then drawn off and analysed. This analysis is highly important because for work in confined spaces, an explosive must not only provide power but must do so without producing an excess of poisonous gases. Moreover, the character of the gases indicates whether or not the explosive tested was made on a formula so balanced that detonation was complete.

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HERCULES POWDER COMPANY
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Sign and mail this coupon for a free sample copy of The Explosives Engineer—the only magazine devoted to promoting safe and efficient methods of blasting about which every engineer should know something.

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2398

Technical Journalism

(Continued from page 342)

lancing leads into almost virgin territory and is scarcely even defined in extent or power. It is therefore the most precarious, offering an unknown degree of success to the persevering and the lucky. It is to be placed in the background and held in reserve by those whose originality and love of independence lift them beyond the considerations of wealth or permenent employment. It is the crust of the pie, which must be consumed only after the rest has been successfully eaten.

Industrial Publicity

Organized industrial publicity is comparatively new, having grown out of straight advertising. It was born of the need which large corporations have felt for careful and accurate representation in the public prints, and for the more frequent appearance of their names and trade marks before the public eye. However well the great advertising agencies were able to handle industrial work, they could never bring to it the technical knowledge required in a discussion of the special products of many diversified manufacturers. They could generalize successfully, but they could not provide the many services which the company's own publicity department was able to give. Only a few of the largest concerns have entered the publicity field on a large scale so far, but it is certain that this function will eventually be adopted as standard practice by all manufacturers doing a national business.

To the young engineering writer, the advantage of industrial publicity lies in the fact that it gives steady employment and excellent training. It introduces him into the mystic procedure of writing for the public prints, and if he has imagination and patience it gives him an excellent background for future writing in wider fields. It teaches him something of business, of manufacturing methods, of research and applied science, of patent law and of sales promotion. It gives him a team sense, and implants in him the faculty for getting jobs done on time. But above all it trains him in diplomacy and in the finesse of obtaining useful facts for the preparation of material suitable for publication. He learns how to make sure of the accuracy of his information; he discovers how to induce busy or balky engineers to uncover good stories; he obtains the critical faculty which enables him to choose between the "scoop" story and the "dud"; he learns how to decide whether it is expedient to release a thing or to keep it under his hat; and he gets the feel for the big things that are going on around him, which is another name for the reporter's nose for news. Altogether, he is in a broad field, but one in which the sky is *not* the limit — his "ceiling" is distinctly low.

Specifically, corporation publicity includes the writing of advertising copy, bulletins, descriptive sheets, recruiting literature, data sheets, instruction books and sales information. It also embraces the preparation of press notices of new equipment, of discoveries and inventions, and of business and personal material; and the writing of newspaper and magazine feature stories when occasion warrants. Some companies publish technical magazines such as the *Stone & Webster Journal* the *General Electric Review*, and the *Bell Telephone Quarterly*. These rank as engineering journals, and are issued to a regular subscription list. The work on them is similar to that on outside publications which I shall mention later.

In addition to the above activities, it is the duty of the publicity department to assist the engineers and scientists in the preparation and handling of articles for the trade press, newspapers, and sometimes for the general magazines or the society journals. In this capacity the department acts as a literary agent, making editorial suggestions, handling typographical work, obtaining photographs, and submitting the material to editors. Out of this work grows the wide contact which the department must maintain with publishers and writers, in the course of which the publicity man makes numerous valuable acquaintances in the literary world. It is also common for writers, editors and newspaper men to pay visits to the manufacturing plant on special story assignments and interviews, or to attend demonstrations of new discoveries or new equipment. Here again the publicity man is the liaison between the company and the outsider, often playing the host as well as the provider of the desired information.

Most large concerns add to these activities a good deal of internal publicity, directed toward the employees themselves. This takes the form of house organs, bulletins, etc., and is usually not of great interest to technical graduates, although it provides an interesting field for those who are anxious to specialize in the relations of management and labor.

The degree of organization which appears in a publicity department depends on how well "sold" the company is on its advantages. In a small concern the whole business may center around one man, while in a large one the work may ramify so widely that there are special sections for routine work, news, internal and external publications, technical motion pictures, lecture service, college news service, radio and the like. In a big organization the live man may find out new ways of assisting company publicity all the time, and if so it is likely that he will find the opportunity a good one.

The industrial concerns of the country are rapidly awakening to the value of organized publicity and consequently there are numerous companies just launching such departments, preferring to start out upon their own, to continuing to draw entirely upon the advertising agencies. These embryonic departments offer good opportunity to writer-engineers who have had some publicity training, but are likely to be difficult for the man with no previous experience. Advertising usually plays the important role in the beginning, but if the start is a small one the man who gets the job of organizing it is likely to have free rein to build up in any way his ingenuity suggests.

The outstanding fact about these corporation publicity departments is that very few technical men are employed. A nucleus of experienced newspaper or advertising men is usually surrounded by others recruited from high schools or general college courses. But however good these men may be in ferreting out stories, their lack of engineering training is bound to handicap them, so that the man who has such training is at once in a favorable position to go ahead — provided of course that he is able to handle words. There is no doubt but that the engineering graduate will be more and more in demand in positions of responsibility in publicity work as time goes on.

There is one danger in this field, and that is the narrowing influence which it exerts upon the writer. The work deals with one product or with a series of products in a single class, and consists of a profusion of detail, and a repetition from day to day of releases closely following one pattern and always saturated with one thing — the company "slant." Anybody who has written advertising knows how important it is to bluff it through, making weak points strong, and strong points magnificent. While this does not necessarily make a liar of a man, it trains him in judicious exaggeration, and finally leaves him with a bias

(Continued on page 346)

Aerial view of Dallas, Texas

Dallas—A Skyscraper City of the Southwest

A GREAT change in the skylines of this country has taken place in recent years, especially in the West. Where formerly great expanses of open range were the rule, now the West is dotted with rapidly growing cities and towns, and where one and two-story buildings were ample for the commercial needs of these cities, today the tall building is necessary.

More and more, as the center of population moves steadily westward, our cities beyond the Mississippi are growing upward, and Otis equipment and Otis service, instantly available anywhere, are doing their part in the vast development program.

All skyscrapers, East or West were made possible by the elevator—and the world's first *safe* elevator was an Otis.

OTIS ELEVATOR COMPANY
OFFICES IN ALL PRINCIPAL CITIES OF THE WORLD

Technical Journalism

(*Continued from page 344*)

which is sometimes difficult to get rid of. It is possible to become "hard boiled," of course, but if you do that you deliberately quench your natural enthusiasm for the work, and get to be a mimeograph machine. In the last analysis, I believe, it is better to get out before the bias threatens to get into the blood stream.

Corporation publicity, then, is a better field for training purposes than for lifelong employment. As a training ground it is equivalent to the newspaper for the cub reporter, offering as it does every kind of engineering writing, and contact with situations and people of every description. From the compilation of the most tiresome data sheets the publicity man will suddenly be drawn into a "scoop" story and will play host to editors and star reporters from all parts of the country. Every minute there will be something going on well worth his attention, and if he enters the job with his eyes open and with the resolve to keep on the jump, he will get a good deal out of it all. But he must keep constantly on the move about the plant; he must know the products thoroughly, and how they are made; he must know the key men in every department; he must be conversant with the general state of the art and with the progress of research. If he accomplishes these things he will be ready, after a few years, to take an engineering literary job of considerable importance.

Technical Journalism

Probably the highest goal of the engineering writer is an editorial post on an important technical or trade journal. Editorial work is not, as might be supposed, a matter of commas, ands and buts, to be inserted into the other fellow's contribution. On the contrary it is a position of real leadership. The engineering editor is an important influence in his field, and may easily become a considerable force in the profession. He exercises a discretional power over what he prints and thereby helps to mold engineering thought to a large degree. His is the responsibility for the standards to which technical writing is held, and his the opportunity to initiate trends and even reforms in the technique of the profession.

The editor has, also, constant opportunity for valuable personal contacts, often with the leading men of the profession throughout the world. Whether an interview be with a perpetual motion fiend or with a cabinet minister, the editor is sure to derive something of interest and of value to himself and to his work.

Then, too, a constant stream of editorials must be written. The field for these is almost limitless, and the man who can write clearly and forcefully, seeing the wide sweep of his profession before him, may often find that his influence has reached to far corners of the earth. There are many types of editorials — those which remind, those which simply state an issue or clarify it, those which argue or exhort to a definite end, those which propose new lines, or point out new avenues of progress which should be followed. Almost any type of mind, whether the logical, the speculative, the descriptive or the propagandist, will find an outlet on the editorial page.

Beside the editorials, which are often a secondary feature, the magazine editor's work is to gather and present articles which represent the best thought of the time in his engineering field. By his skill and vision he must determine in advance what his readers will most want to read, and what will give them the best picture of their field.

There are other services which the paper may render also. News of the industry and its allied professions must be gathered and presented promptly and readably. Information and data on new developments must be given constantly. From time to time reviews of progress and forecasts of future trends are needed. Services such as questions and answers, new apparatus news, commodity prices, construction and financial statistics, are to be provided for the reader. And in all this the editor is the man who gathers, selects, eliminates, fixes the proper emphasis, and presents in attractive style the material which in his judgment will render the greatest service to his readers.

By virtue of their position editors also enjoy an important place in the affairs of the profession as a whole, quite outside of their editorial work. The members of a paper's staff are often called upon to address engineering, business and civic gatherings, and are frequently asked to sit on technical or government boards of more or less importance. In their capacity as reporters of conventions and scientific meetings, they often take leading parts in the discussions and in the work of the numerous committees. The chief editors of important papers are usually men of great distinction and sometimes of great achievement in the profession. The ultimate opportunity, therefore, for the well trained engineer who also has literary talent, is unparalleled in the journalistic field.

But a man cannot become an editor overnight, or, for the most part, immediately upon leaving college. The great essential for this career is previous experience, added, of course, to the necessary talent and fundamental knowledge. It is for this reason that I strongly advocate a few years in industrial publicity or some similar activity before trying to make a magazine connection. A period of actual practice in the profession will also be found exceedingly valuable. There is no sounder way of becoming acquainted with the needs of a magazine's readers than to be one's self a reader first.

Knowledge, experience, and the ability to write are indeed important in editorial work, for there are many engineers who aspire to write for publication who cannot properly express themselves or who have not a clear idea of the significance of the things they write about. It thus devolves upon the editor, after he has unscrambled the English of an article, to decide whether it is accurately stated, whether the subject is prop-

(*Continued on page 348*)

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Above: Sullivan Rotators in the cut-off trench. A Bravo drill boring grout holes is in the background.

At right: Two 870 cu. ft. Angle Compound Compressors supplied air power.

Above: Three of the Sullivan "T-3" drills on quarry bars, channeling limestone blocks in the quarry.

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In building the dam, modern engineering overcame one after another of nature's obstacles.

Sullivan Diamond Drills took 2-in. cores 50 feet deep in the bedrock to determine its safety for the dam; and to reveal seams, which later were filled with cement to prevent seepage, underneath.

No sand for concrete was available—so limestone blocks were chiselled from the river bank, to form the dam. Line drilling with Sullivan Rock Drills and quarry bars, removed the blocks from the quarry. Eight of these rigs drilled 28 miles of hole in one month.

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SULLIVAN TRADE MARK

SULLIVAN MACHINERY COMPANY, 164 S. Michigan Avenue, CHICAGO

Offices in all principal cities of the world

Technical Journalism

(*Continued from page 346*)

erly handled, whether it is timely and of sufficient interest to claim the time of the reader, and whether controversial points are handled with the proper diplomacy. If the editor fails to shape the article to these requirements, it is far more the paper which will suffer than the author. While it is obvious that the editor cannot know as much as all of his contributors put together, he must be well able to vouch for their statements, and must bear the full responsibility for what they say. And here, in parenthesis, I might admit that this is an ideal condition not always attained, so that one of an editor's chief requisites must be the ability to extricate himself gracefully from the complicated situations into which his own shortcomings will sometimes plunge him.

Nor does an editor spend all his time entertaining the presidents of societies or slashing at defenseless copy with his famous blue pencil. There is also a considerable manufacturing problem connected with a magazine, and no matter how well organized his print shop and art department may be, he must have a good grasp of the technique of bookmaking in all its branches. There is the layout of articles, the choice of titles and the type in which they are set, the making of cuts, and the scheduling of material in such a way as to make each issue well balanced and interesting. There is the deadly rush to get news material in while it is still "hot," and the equally deadly necessity of "writing to fill" when something goes wrong and the printer sends up page proofs with a bunch of slugs where the type has fallen short of the expected space. And on top of it all there is the constant reminder that the cheapest way must be found to do everything; that certain rights of advertisers and readers must never be violated, and that the Post Office Department has a set of rules which must be followed to the letter.

These things are all part of the romance of the publishing game, and while the editor may be conceived as a man in shirt sleeves who smokes cigars all the time and only takes his legs off his desk to rest them, a few weeks in the midst of a lively journal serving an industry where things are happening all the time, will convince the most skeptical that this career is no place for a nervous man, nor for one who is looking for a quiet corner in which he may permanently immerse himself in peace. It is a grand game, quite as lively, I am sure, as the stick-up racket.

Popular Scientific Writing

Of the remaining two fields open to the engineering writer — newspaper work and freelancing — I cannot put down much definite information. I can only draw an optimistic picture which I hope to find, some day, to be borne out by the facts. The main attribute of these pursuits I conceive to be freedom — a sort of Arcadia in which one typewrites an hour or two every morning, files a few acceptance notes from editors, deposits a few checks, and then catches a train for some place where big things are waiting to be written up, or accepts an invitation to fly to South America or to be the first public witness to the cracking of the atom. In that fair country there will be no commuting, no punching of time clocks, no printers and engravers to argue with — only assignments pouring in from all sides, rates gradually rising from a penny per to ten cents a word, and finally a secretary to track down the dope, wheedle photographs out of reluctant business magnates or cumbersome government bureaus, and lug the typewriter off to be re-riveted and re-nickel-plated from time to time.

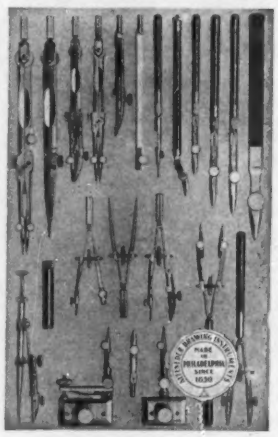
Fantastic? Perhaps; but there are such men, some of them on newspapers, some buried beyond discovery in idyllic country places or in the gurgling waters of far-away trout streams, some, strangely enough, digging ditches or selling washing machines incognito, gathering, absorbing, turning scientific and engineering material into words that stir millions. The thing has been done, is actually being done every day. And why?

We have come to the point in this mechanical age when the public cooperation and enthusiasm are necessary to technical progress. It is no longer possible nor right to retire within the sacred walls of the scientific institution and carry on researches on the "public-be-damned" policy. The day when scientists were supposedly inhuman thinking machines is gone, and the public demands to know about them and their work that it may give them its support and appreciation.

So far, practically the only men able to fill this peculiar want are the old newspaper men. With their long experience in news writing they feel that they know a "story" and can put over whatever scientific news may be worth reading. But how are they going to get it? Their lack of technical training often leads them to miss the big points in engineering and scientific progress, and the professional men complete their downfall by supplying them only with a few conventional facts and figures which in themselves do not contain the essence of the story at all. This must be changed. We must have popular scientific writing done by men who understand the technical slant, and at the same time know how to put the big points of a story to the fore in language that laymen can understand and enjoy.

But the way is not easy, any more than the path of the independent writer in any other field is easy. There must be years of hard sledding, when the lowliest kind of success must do, when every article that fails to detonate in an editorial office must be chalked up as a blank fired only for target practice. There must be methodical, grinding work, with a willingness to do the bread-and-butter stuff that is not the pot-boiler but gets pot-boiler compensation. There are no signboards on the road, nobody to teach you how to progress, nor to whistle you back on the trail when you go astray. It is an unmapped country but a wide one — just the kind of

(*Continued on page 350*)



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FITTINGS

Gate Valves and Boxes

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Gas Producers

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THE "MATHEWS" FIRE HYDRANT dates back to the late sixties, when Hydrants were largely the product of local foundries and the designs many and varied.

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Today, with over three hundred thousand in service, it occupies first place, and the long list of users is constantly growing.

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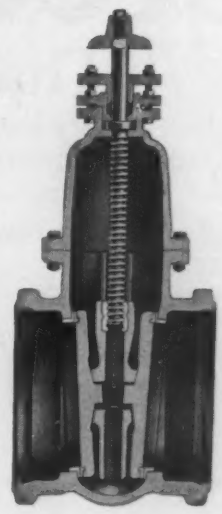

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Technical Journalism

(*Continued from page 348*)

territory for the pioneer. The claims have not yet been staked out, for there is practically nobody there yet to stake them. Who is more fitted to set his face toward this great country than the man whose training and talent fit him definitely for the job — the engineer who has the genius for expressing himself on paper?

Departmental Notes

(*Continued from page 338*)

satisfactory investment. It is not at all unusual to find in even the smaller industrial research laboratories that a certain amount of time or a certain number of men are set aside for research in pure science with no apparent relation to the companies' immediate business. This has been found to be a wholesome procedure for the development of the laboratory staff and for the benefit of the public, and makes such industrial work much more attractive.

C. L. Norton.

Meteorological Problems

(*Continued from page 329*)

For the continually moving boundary line between the cold equatorial current and the warm polar air they introduced the name "equatorial front." Synoptic maps of these upper layers are few and far between but they seem to back the theory of the equatorial front.

What practical benefits may be derived from these studies of the upper atmospheric strata? It would seem that they could have no influence upon the weather since they are poor in water vapor content, and therefore, are free from all condensation phenomena. However, indirectly they exert a profound influence. Every cold equatorial wave in the stratosphere causes a great pressure rise at the surface. Thus, the pressure distribution at the surface is largely determined by the pressure distribution in the stratosphere. The movements of storms and rain areas are determined by the surface pressure distribution; thus, an intimate connection exists between the air movements of the upper layers of the atmosphere and the weather at the ground.

The preceding lines give, I believe, a fair illustration of the problems now under discussion in synoptic meteorology. However, no article on this subject would be complete without a word about the aeronautical applications of meteorology. In the last few years special weather services for commercial and military airways have been established throughout the country with the purpose of providing the pilots with information regarding the weather and wind.

The introduction of fronts on the weather maps has shown that poor visibility and low clouds, the two worst enemies to successful aircraft operations, largely are confined to narrow strips along the fronts or demarcation lines between air masses of different origin. Thus the success of an aeronautical meteorological service will largely depend upon its ability to detect and follow, on the weather maps, such fronts even when they are weak and not very well defined. The necessary prerequisite for such a study is the organization of meteorological sta-

(*Continued on page 352*)

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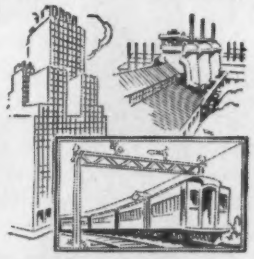

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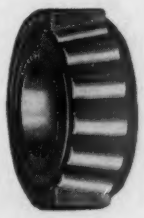

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Meteorological Problems

(*Continued from page 350*)

tions at frequent intervals, along and surrounding the airways, and generally not more than 30 or 40 miles apart, against 150 to 200 miles in the old days.

This development, forced upon meteorology through the development of aeronautics, has already proved highly profitable to both. Where the old-fashioned weather maps indicated nothing but irregular variations in conditions from station to station, the modern analysis, based upon detailed reports from a great number of stations, usually shows a very well defined and intelligible microstructure of the atmosphere.

Knowledge of this microstructure enables the meteorologist to advise the pilots, not only when to take-off, and when not to take off, but it also enables him to determine the best flying level where the maximum tail wind may be expected. Sometimes the weather may close the regular airway for traffic, yet the meteorologist is in a position to suggest to the pilot a detour on which he will get him through. Thus, a meteorological service, based upon frequent reports from a great number of stations, while contributing to our knowledge of the "Feinstruktur" of the atmosphere, also enables us to increase both the safety and efficiency of aircraft operations.

Marine Power Plant

(*Continued from page 334*)

the voltage is high the contacts remain closed a relatively short while, thereby decreasing the excitation. The frequency of the vibrator is 60 cycles and there is therefore no perceptible flicker of lamps. Variation from normal voltage does not ordinarily exceed two per cent.

The acid test of all engineering matters is supplied by experience and it is still too early for final judgment. The *Chelan*, the first of the new ships, had her trials in July, 1928, and since then has cruised upwards of 20,000 miles with complete success and with a marked improvement in fuel consumption as compared to earlier ships.

Elaborate trials were run on the *Pontchartrain*, which was the second of the new ships, and the performance of all of her machinery was measured with a high degree of precision. A complete report of the trials was presented before the Society of Naval Architects and Marine Engineers in November, 1928. A tabulation which forms a part of this article shows some of the results obtained on the *Pontchartrain* and in parallel columns the results obtained on the *Modoc's* trials in 1923. An examination of the tabulation will show the extent to which expectations have been realized. On the first and fourth runs of the *Pontchartrain* auxiliary power was furnished by the auxiliary generator. On the second and fifth runs auxiliary power was furnished by the main generator. On these two runs the main turbine was not bled for feed heating. On the third and sixth runs auxiliary power was furnished by the main generator and steam was extracted from low stages for heating feed water.

The two ships are comparable as to size, tonnage, power, speed, boilers and propelling machinery. Refinements have been made in hull design of the *Pontchartrain*, and she is fitted with a contra-propeller for rectifying the propeller steam. She operates on steam

(*Continued on page 354*)

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Marine Power Plant

(*Continued from page 352*)

at 250 pounds (gauge) pressure and 250 degrees F., superheat, whereas the *Modoc* has 200 pounds and 90 degrees. All these are very real improvements and make for reduced operating costs. But the outstanding fact of all is that the *Pontchartrain* auxiliaries take only 25 per cent as much steam as those on the *Modoc*.

In the comparison of machinery of ships it is customary to consider fuel consumption for all purposes in pounds per shaft horse power per hour referred to the propeller shaft. This figure for full power operation is *Modoc* 1.195, *Pontchartrain* 0.823; for cruising speed *Modoc* 1.535, *Pontchartrain* 1.079.

As to the applicability of this system to steamships in general, the following points are worthy of consideration. If auxiliary power requirements are in excess of 250 kilowatts it might be more advantageous to supply this power from an auxiliary turbine having at least five stages and exhausting against not more than one pound back pressure absolute. If the requirements for auxiliary power are below 250 kilowatts the difficulty of obtaining a multi-stage auxiliary turbine of good efficiency is greater and the advantage of connecting up to the main plant is increased.

Capital investment is always a matter of much concern to shipbuilders. For the new Coast Guard ships the total cost of machinery and boilers f. o. b. factory was $173,000 per ship, which included all machinery except windlass, capstan, steering gear and quarters ventilating fans.

Arc Welding was recently put to a new use in a galvanizing plant where it was used to mend leaks in a tank caused by hot zinc.

Arc welding was used because all work could be done from the inside, thereby saving the expense of tearing away the combustion chamber and foundations.

Research Laboratory

(*Continued from page 327*)

mands of industry are so heavy that it is at present necessary to add approximately half the staff as new research assistants at the beginning of each year.

Although practically all members of the staff are full time research workers, the laboratory permits them to attend three to five hours of courses per week. The purpose is, of course, to assist in the training of men by this method and it is especially attractive to men from other institutions. A number of the men are candidates for the degree of master of science and a smaller number are working toward the doctor's degree.

The laboratory's technical accomplishments may be most readily visualized by referring to the list of publications from the Department of Chemical Engineering, of which it is a part. The number of publications has reached well over two hundred, and of these approximately eighty per cent are by men in the laboratory. The majority have been in the field of corrosion, concerned with both theory and application. The most practical results in this field during recent years have been in development of a method for rust removal and in reduction of corrosion in the refrigerating industry.

Another problem of general interest was in the laundry industry. Largely through the efforts of the laboratory, and particularly through its study of deterioration of fabrics due to laundering, the industry has taken more interest in the control of operations. Thermometers are becoming standard equipment on individual machines and the quantity of bleach and the temperature of operation are being watched more closely.

The outstanding achievement along technical lines was undoubtedly the application of vacuum distillation to lubricating oils. This problem was first carried out on a strictly laboratory scale and then on a much larger or semi-plant scale at the Institute. From the latter investigation, data were obtained which were then used to design large scale stills. The value to the company for which the work was undertaken can hardly be estimated, although it is certainly millions of dollars. Incidentally the research worker who carried out the investigation is now in charge of all research and development work in the large oil company which supported the work.

In conclusion it might be well to give a list of the general research programs now being investigated. It should be remembered that such a list necessarily includes only thirty-five per cent of the laboratory's activities, since the contract work is in most cases confidential, at least until completed.

In the field of corrosion two specific problems are now being studied: the mechanism of inhibitor action, with particular reference to hydrogen evolution and adsorption in pickling steel; and the corrosion of cast iron and steel, and of the effect of rust films. The mechanism of adhesion and particularly the effect of plasticizers and other additional agents in glue is also being investigated. Research on oxidation and polymerization of linseed oil, and on the deterioration of cellulose, with particular reference to the use of inhibitors, are also under way. A study of catalysis with particular reference to the methanol reaction has been practically completed and research on the cracking of lower hydrocarbons has been undertaken. Among other lines of investigation carried out in coöperation with members of the Chemical Engineering Department are: study of deviation from Raoult's law in hydrocarbon mixtures; transfer of heat in condensing vapor from a mixture containing non-condensible gas; effect of heat transfer on coefficient of friction in pipes. Other problems may not be enumerated owing to the confidential nature of the work undertaken.

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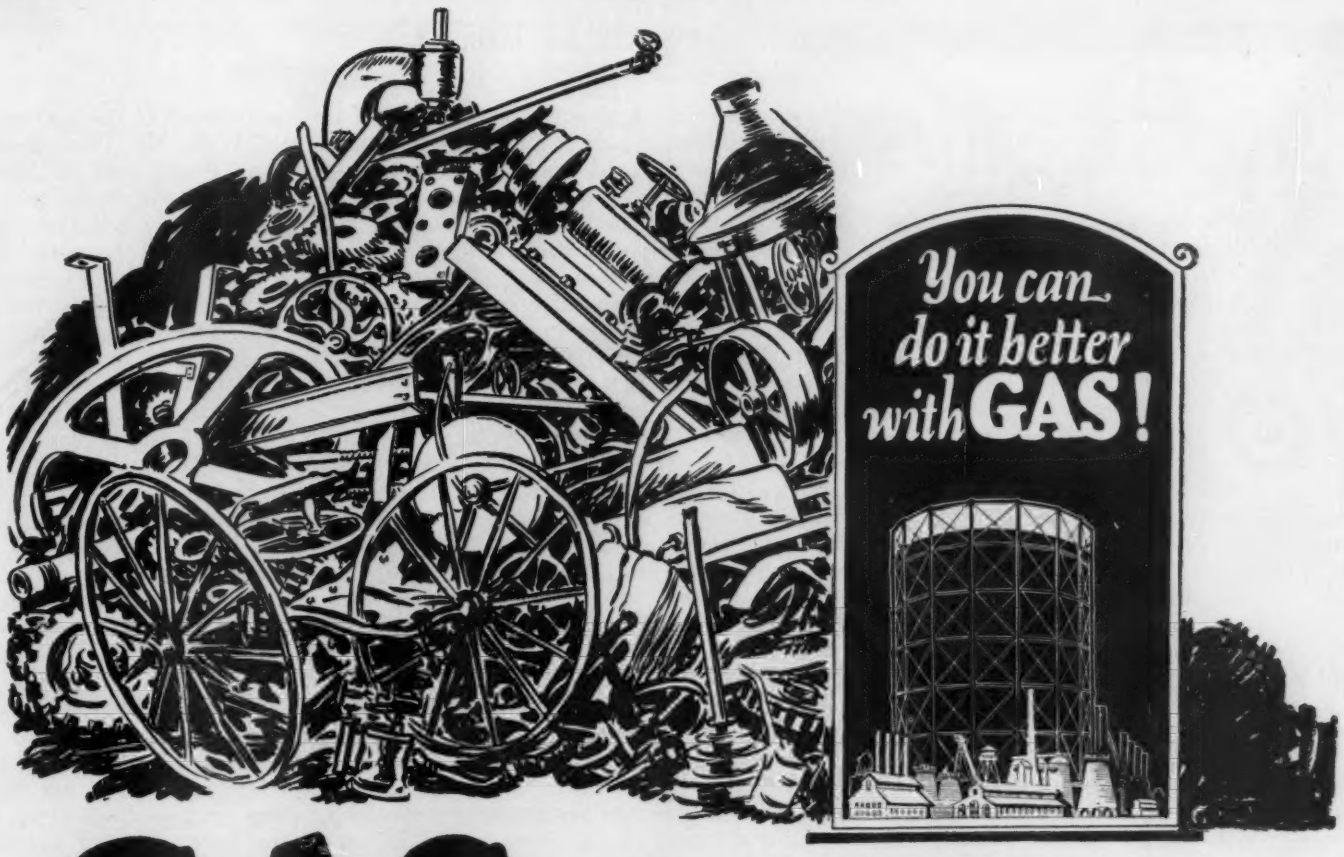

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It is surprising how the application of gas in industry sometimes brings about complete changes in time-worn methods. . . .

An example (which may have its counterpart in your own plant) is found in varnish making. Varnish must be heated to a definite pre-determined temperature, and removed from the heat at the precise, critical moment. Failure to observe these requirements means that the entire kettle of varnish is spoiled.

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The Proper Attitude in Business

(*Continued from page 326*)

be a confession of weakness and he was very reluctant to ask for help. If a problem came to him which was somewhat out of the routine, he decided how it should be handled, either from a fancied similarity to some other problem he had seen or by some uncertain process of reasoning, with the result that the answer was apt to be wrong. I tried to impress on this man the fact that if he would recognize his limitations and take only the responsibility for decisions which he was qualified to make he would be a much more valuable man to himself and to the organization. If I could have put a screen in front of him which would have allowed only problems within his scope to reach him, all would have been well, but unfortunately he had access to all the problems, large and small, and he could not resist the temptation of trying to handle work which was too big for him.

It often seems as if college men have a wrong idea about mistakes. While at school some percentage materially less than 100 will usually give a "pass" and a student is apt to think it means that if this percentage of his work is correct he has done all that is expected of him. He fails to realize that his mark is not so much the measure of accuracy as it is the amount he has learned of the subjects assigned to him and that, while 85 per cent may pass while studying calculus, if he had to do a number of simple examples in arithmetic he should get 100 per cent as the work was well within his capacity and there was no excuse for making mistakes.

From time to time some one brings me an article written by Newton Newkirk, which reads as follows:

"The man who never made a mistake never took a chance. Risk nothing, gain nothing. The ultraconservative stands still. 'Safety First' may become a saffron-streak.

"A mistake analyzed is an asset — you can make it worth all it costs you — some mistakes even pay big dividends in after years.

"Don't plunge. Look before you leap, but if the 'lighting' seems sound, take the tumble. As long as you are haunted by the fear of a faux pas you will fiddle along in your old footsteps."

There are two kinds of mistakes which, for want of a better term, I shall call those of judgment and those of repetition. I know that you will agree with me that, while Mr. Newkirk's comments apply to errors of judgment, they do not justify errors of repetition.

Some time ago I had occasion to make up figures comparing the results of operation of twenty-eight companies. The time was limited and I had to cut every corner I could, so I called one of my students and, telling him what figures I wanted, said, "Begin at Abington and work down the list alphabetically." I then called a second man, told him the same thing about the figures and said, "Begin with Whatcom and work backward alphabetically." Finally each man came to me and announced that he had completed his work. I then said, "Boys, get together and compare results, and if you differ go through the work together until you determine the right figures." They did so and presently came to me and reported that they had compared results, eliminated mistakes and were sure they had the right figures. Now of the twenty-eight companies twenty-six were comparatively simple, while two were rather complicated. I thought, as a matter of precaution, that I would myself check these two companies. The first one was all right, the method employed on the second was right, but due to some mistake the answer was wrong. I called the two men over, and working with me they were unable to duplicate the answer they had handed me as being entirely correct. We then went back through the remaining twenty-six companies with the result that of the twenty-eight computations twenty-three were correct and five were wrong. Three of the five errors were due to arithmetical inaccuracy; on the other two we could not take time to determine what mistake had been made. When we had cleaned up the situation one of the men turned to me and with a smile said, "Well, Mr. Daniels, we got more than 70 per cent of them right anyway." In spite of the rush I took a few minutes to tell the men exactly what I thought of the work, and when I got through I think they clearly understood that 100 per cent accuracy was required to get a "pass" on that kind of work.

Which do people like best — the dog who is very quiet and reserved, or the dog who wags his tail and is pleased to see you? A few will tell you that they like the quiet dog best; he has "individuality," "strong personality," "great reserve," etc. The majority of people, however, prefer the cheerful dog who wags his tail and shows interest and enthusiasm in what is going on around him, and it is much the same with human beings.

Recently a manager of one of our local companies was in the office in search of a student to take into his company. I selected one of my best men, introduced him and left them to talk the matter over. When I saw the manager again I knew immediately that my candidate had not made a very good impression for he said, "Daniels, if you recommend that man and want me to take him, I'll be glad to employ him, that is, if he wants to come," but he said it without enthusiasm. So I asked him what was his real impression of the man and, with a little urging, he told me just what his reaction was. The man had been very much interested in the prospects which the position opened. He had inquired about the city, the industries, the churches, schools and other points of interest. He had asked what his duties would be, what hours he would be expected to keep, what salary he would be paid and what chances for advancement there were. "In fact," said the manager, "I felt as if my company and I were on trial to see whether he would decide to come with us, rather than that we were to decide whether we wished to take him," and he continued, "What makes it hard is that I have in

(*Continued on page 358*)

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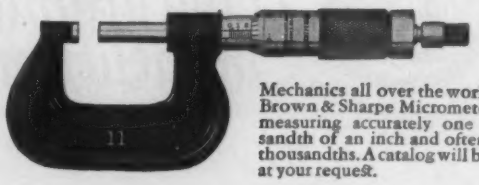

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The Proper Attitude in Business

(*Continued from page 356*)

my company at home three men who are eager and anxious to get the position for which I am considering him. There isn't any question whether they want to come with me; they are eager to get the job and their eagerness and enthusiasm is very evident every time I talk with them. Your man is probably the best man but I wish he had acted as if he really wanted to come with me."

Some philosopher has said that the world is at once unbelievably stupid and unbelievably clever. It often fails to see the things which seem to us to be obvious and which we want to have seen. Conversely, it often detects and interprets correctly the things which we wish to conceal and which we are trying most earnestly to cover up.

One of the great surprises of my early experience with my present employers came after I had been with them for about two months. One rainy Saturday afternoon I had an opportunity of talking with one of the men of the upper circle with whom I had several times come in contact and, after some general discussion of the office and its problems, he got to speaking of the personal traits of the different men, and finally he commented, rather casually, on my own characteristics and those of some of the men immediately around me. We were in a remote corner of the office, we had little direct contact with him, his only knowledge came as he walked through our section and saw us at work, and yet that man had a surprisingly correct knowledge of the characteristics of every one of our group, including myself, and he gave me some quite wholesome advice. The depth and accuracy of his knowledge fairly made my hair stand. I felt he was a very exceptional man, but experience has taught me that the majority of bosses learn to size up correctly the men with whom they come in contact. This is part of their job; if they could not do it, they would not be qualified to be where they are.

The easiest man in the world to fool is yourself, because you are predisposed to interpret things in the way you wish to have them interpreted. Your boss and your associates are often much more hard-boiled than you think, and their minds register a great many impressions which in the aggregate make up their estimate of you, your ability and your fitness for different kinds of work. Even if you consider them in error, their judgment is usually the one which decides whether or not a new position is offered to you.

I could continue almost indefinitely to tell you of the mistakes which college men have made on starting out in business — mistakes which arise from a wrong point of view rather than from any deliberate intention to do wrong — but what I have said will suffice to indicate one sort of problems which lie before you after your graduation.

It is not easy to indicate how you are going to solve these problems. You can learn much about swimming by reading a textbook, by watching others, but there is no way by which you can assure yourself that you can swim except by getting into the water. You can study boxing with the best textbooks in the world and yet I think it will be a distinct shock and surprise when you first get a good blow on the nose. Things of this sort have to be learned by experience, by actually taking your place in the field and learning how to give and take. The essential thing is to fix in your mind a few fundamental principles, get into the game and play it just as well as you are able, and then study the results and see what you can learn by the mistakes or the failures which have come to you. In other words, the way for you to learn how to get along in the world is to actually go out and live in the world.

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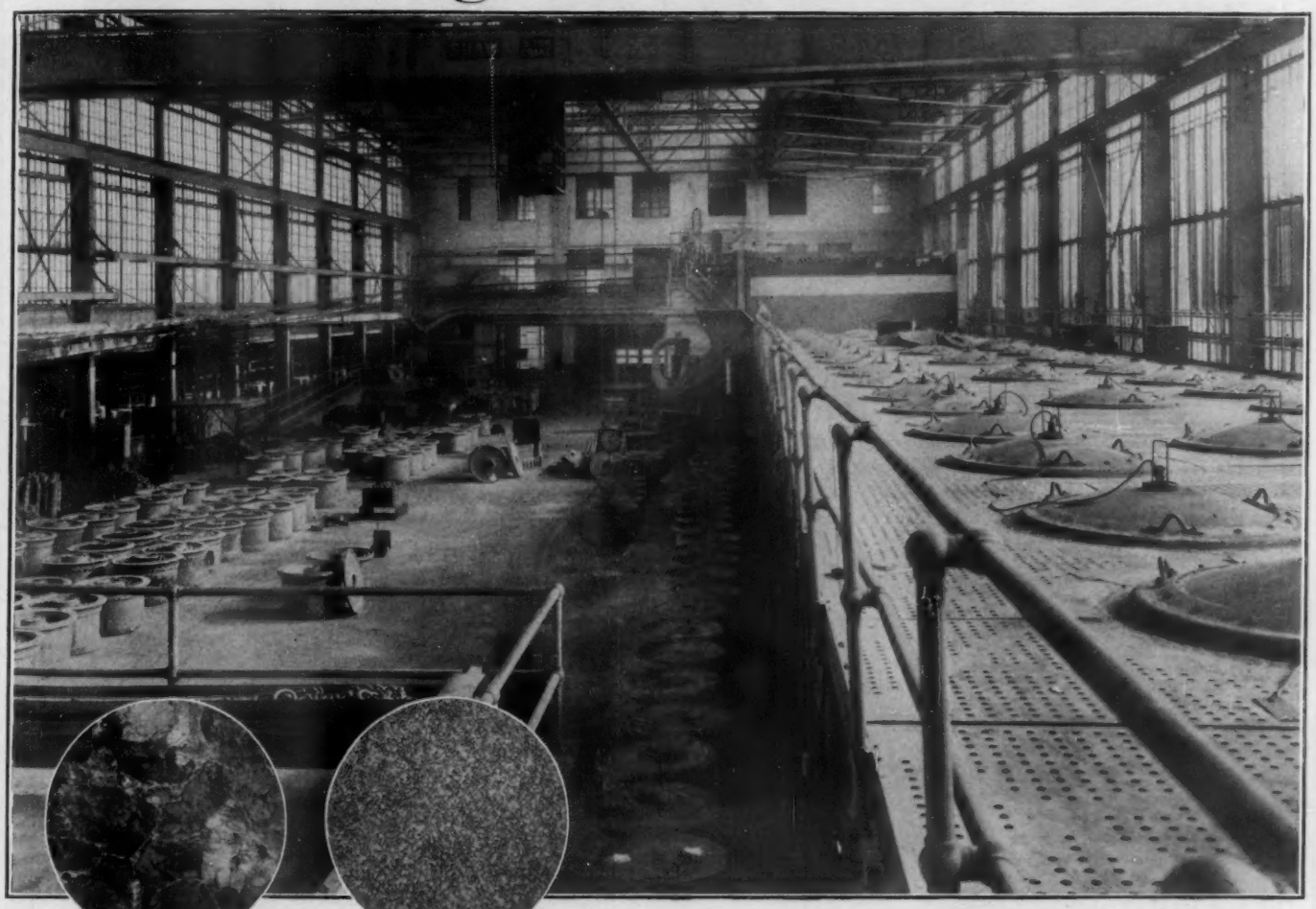

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The grain is refined by normalizing in the batteries of oil-fired furnaces shown above where a relatively high temperature is maintained uniform by the use of electric pyrometers.

After a precisely determined time the forgings are removed and allowed to cool in air. This operation removes the heterogeneous structure of the steel and puts it in the best possible condition for annealing.

Annealing is required to soften the steel and eliminate strains from forging. This heat treatment brings the forgings to a temperature just below the hardening or critical range of the steel and holds this temperature for a relatively long time.

Through special processes unique with this company the steel is spheroidized—or brought to a structure of minute spheres. By this method can New Departure's special analysis, high carbon chrome alloy steel be cut with relative ease without tearing.

Only by an intimate knowledge of metallurgy and the ability to control the unseen in steel are New Departure Ball Bearings produced with a uniform endurance unsurpassed elsewhere in industry.

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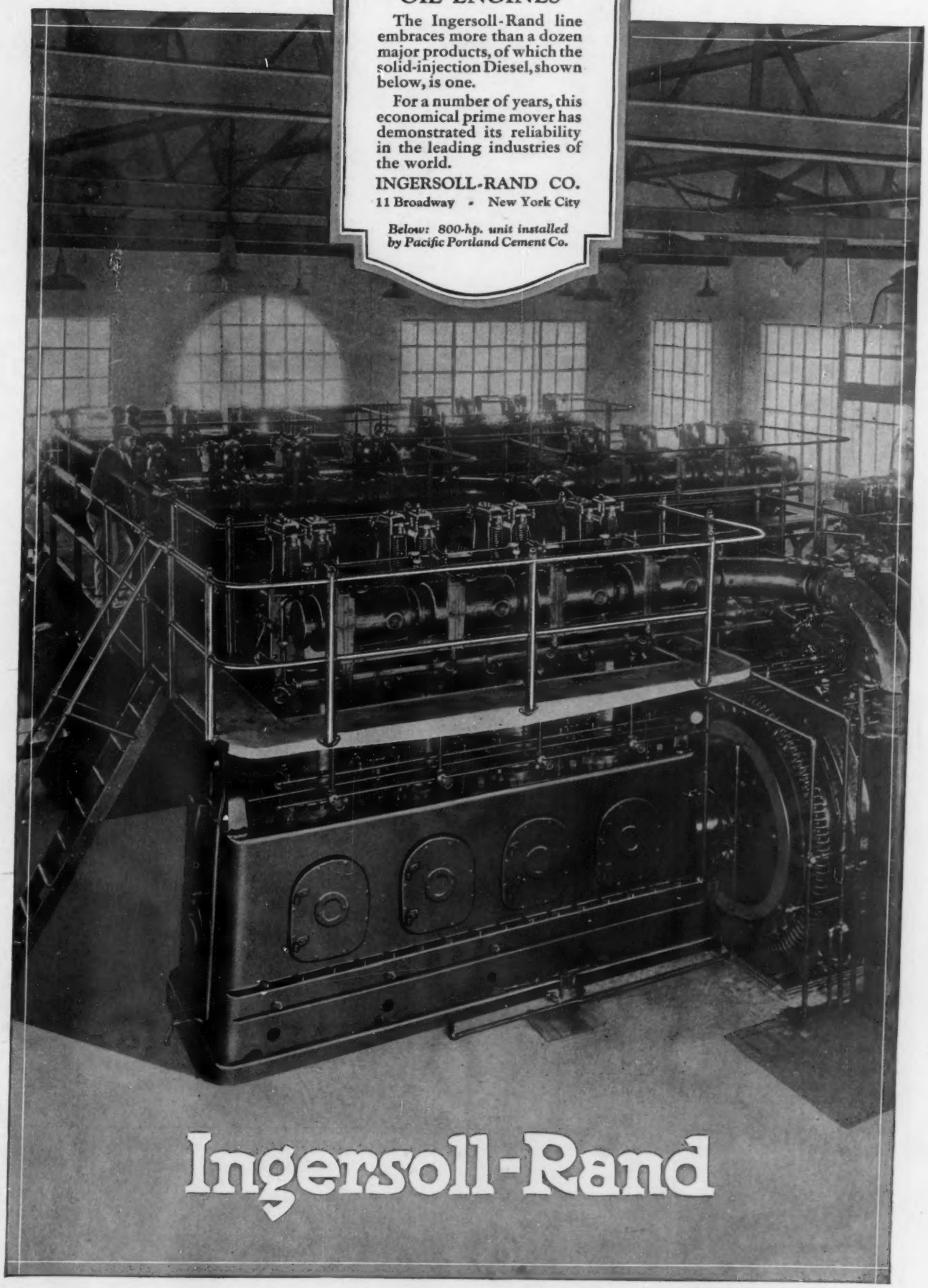

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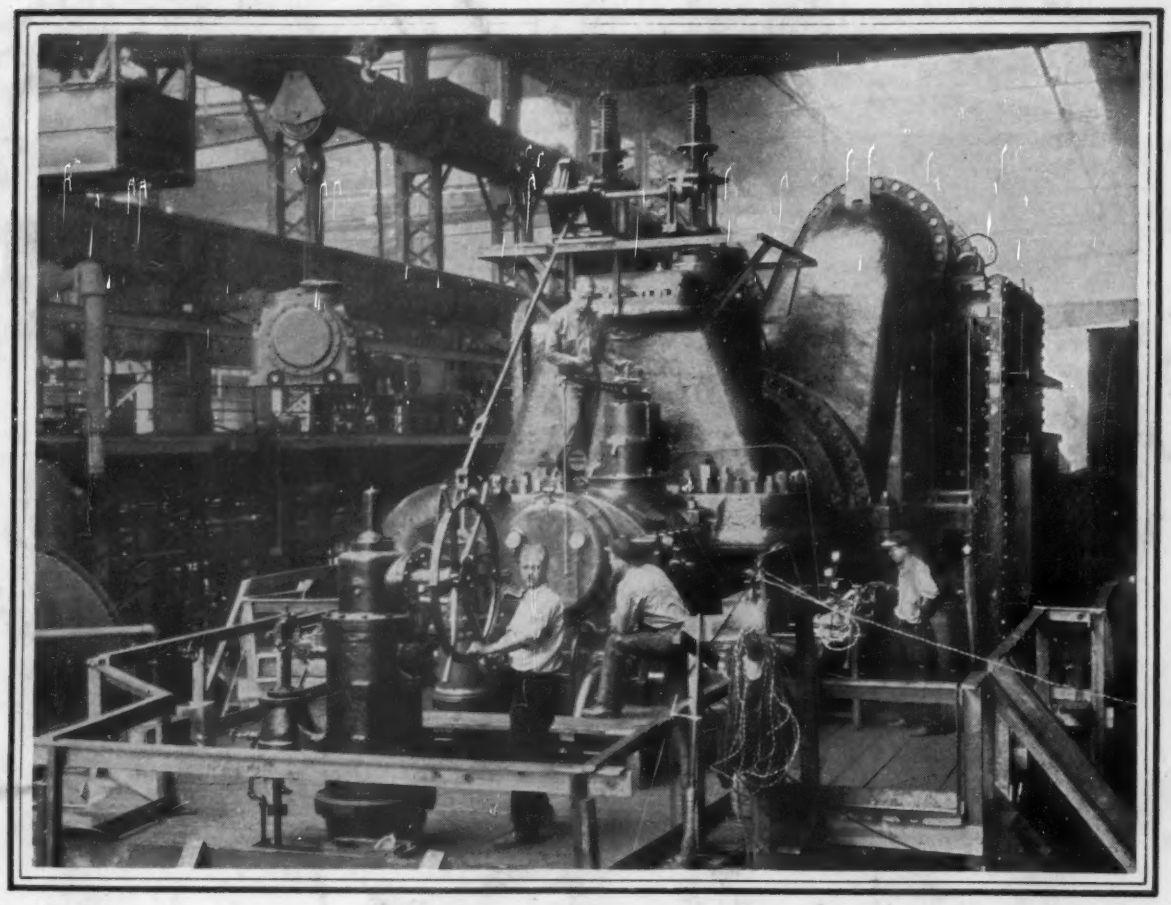

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